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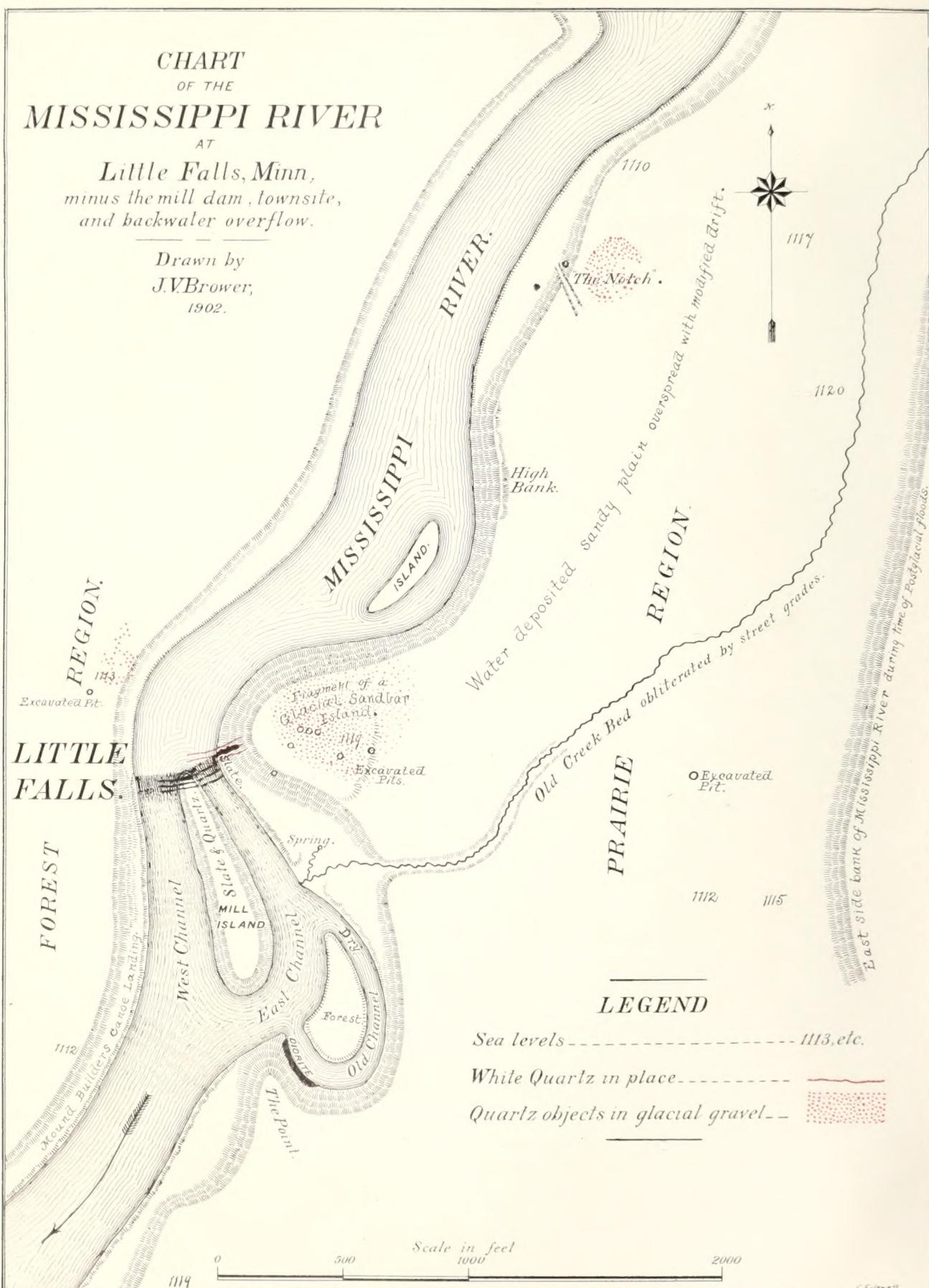
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MEMOIRS
OF
EXPLORATIONS IN THE BASIN OF THE MISSISSIPPI.

VOLUME V.

KAKABIKANSING.

BY

J. V. BROWER,
PRESIDENT OF THE QIVIRA HISTORICAL SOCIETY,

WITH A CONTRIBUTED SECTION BY

N. H. WINCHELL,
PRESIDENT OF THE GEOLOGICAL SOCIETY OF AMERICA,

COUNCILORS OF THE MINNESOTA HISTORICAL SOCIETY.

ST. PAUL, MINNESOTA, U. S. A.
1902.





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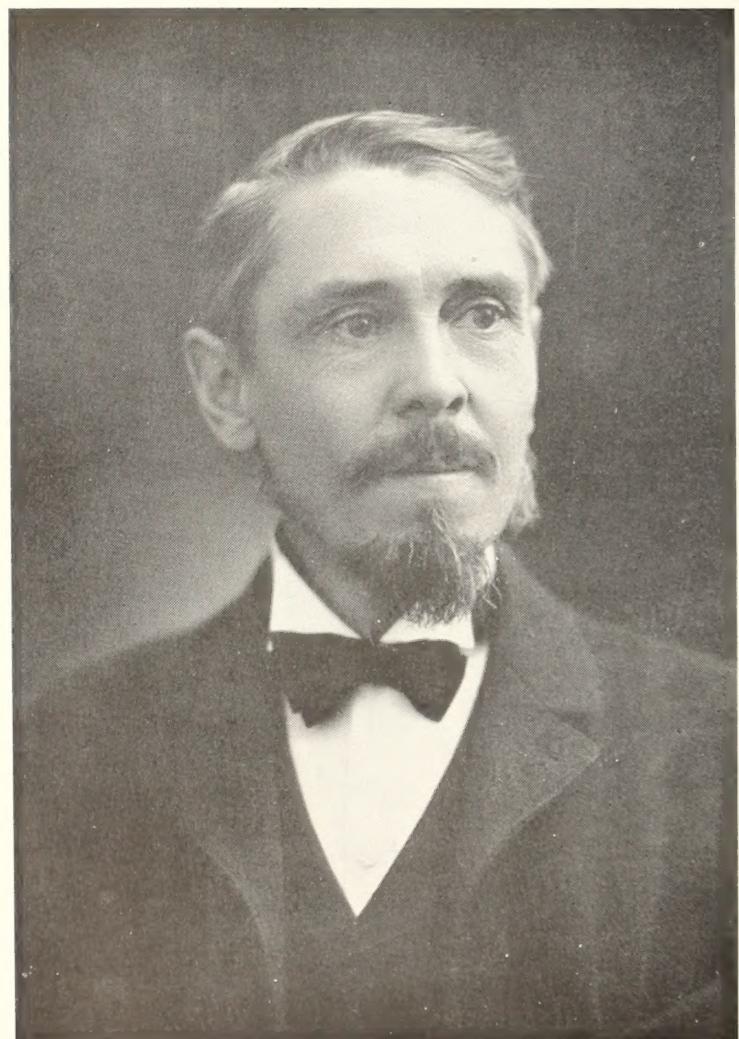
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ST. PAUL, MINNESOTA.

KAKABIKANSING. PLATE II.



Warren Upham

WARREN UPHAM.

In the seventh generation of descent from John Upham, an English immigrant to Weymouth, Mass., in 1635, Warren Upham was born in Amherst, N. H., March 8, 1850. Until his seventeenth year he worked on the home farm. He was graduated at Dartmouth College in 1871, and was engaged in civil engineering for water works and railroad surveys, 1872-74. During the next twenty years he was an assistant successively on the geological surveys of New Hampshire, Minnesota, and the United States. In 1879 he began in Minnesota the exploration of the area of the glacial lake Agassiz, which occupied the basin of the Red River of the North and of Lake Winnipeg.

Mr. Upham has published chapters on the history of the White Mountains and on the river systems in Vol. I of "The Geology of New Hampshire," 1874, and a detailed report on the modified drift in Vol. III, 1878. His work in Minnesota is published in the annual reports of the Geological Survey of this state; and more fully, with many maps, in Vols. I, II, and IV, of its final reports, 1884, 1888, and 1899. His botanical observations are given in the twelfth annual report, for 1883, "Catalogue of the Flora of Minnesota," 193 pages, with a map. The exploration of the part of Lake Agassiz in Manitoba was published in Vol. IV, new series, of the annual reports of the Canadian Geological Survey, for 1888-89; and Monograph XXV of the United States Geological Survey, "The Glacial Lake Agassiz" (658 pages, with 38 plates, mostly maps, 1896), contains a very complete presentation of his studies of that ancient lake and of the glacial period.

Since 1876 he has contributed many papers to scientific journals and the proceedings of learned societies both here and abroad. In 1889 he was associated with Prof. G. F. Wright in authorship of "The Ice Age in North America;" and again in 1896 they were joint authors of "Greenland Icefields and Life in the North Atlantic; with a new Discussion of the Causes of the Ice Age."

In April, 1895, Mr. Upham became librarian of the Western Reserve Historical Society, Cleveland, Ohio; but in November of that year removed to St. Paul, having been elected secretary of the Minnesota Historical Society. He has made extensive researches concerning Minnesota history and biography and the origin and meanings of Minnesota geographic names.

KAKABEKANSING. PLATE III.



Josiah B. Chaney.

JOSIAH BLODGET CHANEY.

The veteran soldier and historical student whose portrait and autograph are perpetuated by the publication of the plate which accompanies this brief sketch, was born at Falmouth, Cumberland county, Maine, October 16, 1828.

For thirty-three years Mr. Chaney has faithfully served as a councilor of the Minnesota Historical Society, a term not equaled by any member now or heretofore identified with that organization. As a councilor, a vice-president, and since 1887, an assistant librarian, he has been present and participating at every meeting of the Society since 1867, except three. While serving two terms as state printer, 1872-1876, he was also a member of the Board of Education of the city of St. Paul, Minnesota.

As an honorably discharged non-commissioned officer of the Second Company of Minnesota Sharp Shooters, war of the Rebellion, he prepared for publication a narrative history of that military organization. His other productions, portions of which are MSS, are entitled:

Chaney's Diary, 1846-7, 578 pages.

Ancient Earthworks, 1881, St. Paul Academy of Natural Sciences.

Letters from Camp, Field and Hospital, 1862, 307 pages.

History of Acker Post No. 21, G. A. R., Minnesota, 1892, 63 pages.

History of Chesterville, Maine, 1782 to 1893, 200 pages.

Maine and the Missouri Compromise, 1894, 128 pages.

The Historical Value of Newspapers, 1896, Vol. VIII, Minnesota Historical Collections.

Care of Sick Soldiers in 1862 and 1898. A comparative sketch.

Mr. Chaney's most elaborate study will be found in his *Maine and the Missouri Compromise*, showing how the District of Maine became a state, being a concise and connected history of the great struggle between the slaveholding and non-slaveholding forces in congress over the application of Maine to be admitted to the union of states, in 1819, which culminated in the Missouri Compromise. The history covers the period from 1602 to 1820.

As honorary secretary of the Old Settlers' Association for Minnesota, he has also continued a unique recorded vocabulary of proceedings which is not to appear in print until after the last meeting of the Association, when it will have only one member.

While at the source of the Mississippi River, October 10, 1901, at Nicollet's Middle Lake, Mr. Chaney made arrangements to join the exploring party which has continued to a conclusion the examination of the gravel beds at Little Falls, Minnesota, in which are involved the Kakabikansing quartz implements and chips.

FIRST EDITION.

THREE HUNDRED NUMBERED AUTOGRAPH COPIES.

NUMBER 108

TO THE HONORABLE, THE COUNCIL OF THE
MINNESOTA HISTORICAL SOCIETY.

MR. PRESIDENT AND GENTLEMEN:

In 1877, Professor Newton H. Winchell discovered innumerable white quartz implements and chippings involved in glacial gravels at Little Falls, Morrison County, Minnesota. They bear unmistakable evidences of artificial fractures by the hand of man. Water-deposited cobbles and pebbles which were laid down by the action of the currents of a great glacial river, are intermixed and closely associated with the chipped quartz blades.

The identity of the blades is in question.

The contents of this *Memoir* conservatively record the history of these quartz objects.

Very respectfully,

A large, ornate handwritten signature in black ink. The signature reads "J. H. Brower" in a flowing, cursive script. The "J." is particularly large and stylized, with a long, sweeping flourish extending downwards and to the right. The "H." is smaller and more upright. The "Brower" part of the name is written in a more standard cursive hand.

INTRODUCTION.

Kakabikansing (pronounced Ka-ka'-bik-ans'-ing) is the Ojibway name of Little Falls, Minnesota, which was in general use there at the time the territory first became the seat of permanent settlements by inhabitants of European descent.

The locality is a stretch of flat, sandy prairie along the east side of the Mississippi River, and the west side is as distinctly a forested region, a few feet lower than is the opposite side in its comparative altitudes near the river.

The two distinct stretches of surface formation mentioned are sharply divided by a bedrock deposit of slate over which the Mississippi has eroded an east and a west channel causing Mill Island to be segregated in the middle of the river.

White quartz veins are abundantly present in the slate as a more recently deposited native silica which is seated in the fissures and cavities of the slate rocks. The quartz when properly quarried, spalled, and chipped into blades, formed available and useful implements for ancient people who at a remote period inhabited the region for a considerable length of time. They established a workshop on the crest of an elevated and compact sandbar formation at the east end of Little Falls at a time when the currents of the Mississippi River at floodstage were periodically sufficient to overflow the entire sandy and gravelly plain where the city of Little Falls is now situated. Many of the blades have been found about 2,000 feet farther up the river on the east side imbedded in sand and gravel, and less abundantly a few of the quartz objects have been recovered from sand banks at the west side of the river which are several feet lower in their altitudes than similar gravel beds on the opposite side of Kakabikansing Rapids.

It is quite remarkable that several distinct explorations could have been systematically conducted at Little Falls with such widely differing results, that the two extremes, formulating a time difference of more than 7,000 years in the age of the quartz implements, are represented

by scholarly investigators who personally examined and explored the quartz deposits mentioned, with such an extraordinary and unsatisfactory variance.

The stability of American archaeology requires that a more definite knowledge of the age and identity of the Little Falls quartzes shall be ascertained, and as the study involves the earliest known appearance of man upon the banks of the Mississippi in the Northwest, it is proper and advisable that duly accredited representatives of the Minnesota Historical Society should undertake an unprejudiced and careful inquiry into all the geologic, hydrographic and archaeologic facts which can be made to correctly develope a better knowledge of the first human beings to place their footprints upon the surface of this state, regardless of personal differences which have created opportunities for acrimonious debate without adequate results, especially so since this Society can be commended and congratulated for labors which are entirely uninfluenced by the results of erroneous and defective conclusions which have been formulated by other investigators.

The Little Falls problem which has been so considerably misunderstood for twenty-five years, has never been adequately illustrated. Many photographs of importance to the study have been made, and a number of them engraved, which, with the charts presented, will more readily present certain existing conditions and facts than do all the pages of the printed record combined.

Paleolithic and neolithic quartz blades and objects have been sharply differentiated in order to intelligently approach a correct separation of the stone and flint implements procured for comparison and study.

A very significant fact is developed by the presence or absence of large quantities of ashes, coal and paint at points of observation. While those materials are plentiful in and about the mounds and neolithic village sites, not a trace of either can be found beneath water-deposited cobbles and pebbles at Little Falls where the paleolithic blades have been excavated.

J. V. B.

ST. PAUL, MINNESOTA, February 10, 1902.

PERSONAL ACKNOWLEDGMENTS.

Professor N. H. Winchell, president of the Geological Society of America, who accompanied the author of this *Memoir* into the fields of exploration at Little Falls, Minnesota, has finally and advantageously united in a careful determination of many of the complex questions which have arisen during the time when those questions were under consideration upon a basis of substantially ascertained facts and acquired knowledge.

I am greatly obliged to Mr. Josiah B. Chaney for his active assistance on several occasions when the gravel beds at Little Falls were subjected to critical inspection and photographic exposures.

Judge John T. Keagy, chairman of the Executive Committee of the Quivira Historical Society, has suggested that the results of the labors of the author of this series of *Memoirs* have been overshadowed by voluminous contributions to its pages by other investigators. The object which has overwhelmingly influenced the preparation of these publications is the preservation of ascertained scientific facts regardless of personal ambitions. The author need not be held responsible for infringements upon space.

Otto Guy Jeffers is fully entitled to consideration for his services during a time when preliminary observations along the shore line of Osakis Lake were valuable as indicating distinct differentiation between mound builder artifacts and Little Falls paleolithic quartz implements.

Professor E. E. Blackman, archaeologist of the Nebraska Historical Society, accompanied the author of this *Memoir* upon a tour of observation about two hundred miles up Platt River, in October, 1901, when the broad expanse of that watercourse, with its thousands of sandbars and islands, vividly portrayed conditions which must have existed at Little Falls when the Mississippi was forming the surface of the plain there by its glacial currents when at a low stage of flowage.

Elizabeth Noltinger is the author of the scene at page fifty-two which suggests a possible hydrographic condition when the glacial floods were tumultuously plunged against the quartz-veined slates at Kakabikansing before the sandbars emerged from the water-washed till.

The typographical excellence of this *Memoir* has been accomplished under the immediate supervision of M. H. Rogers and H. O. Doolittle.

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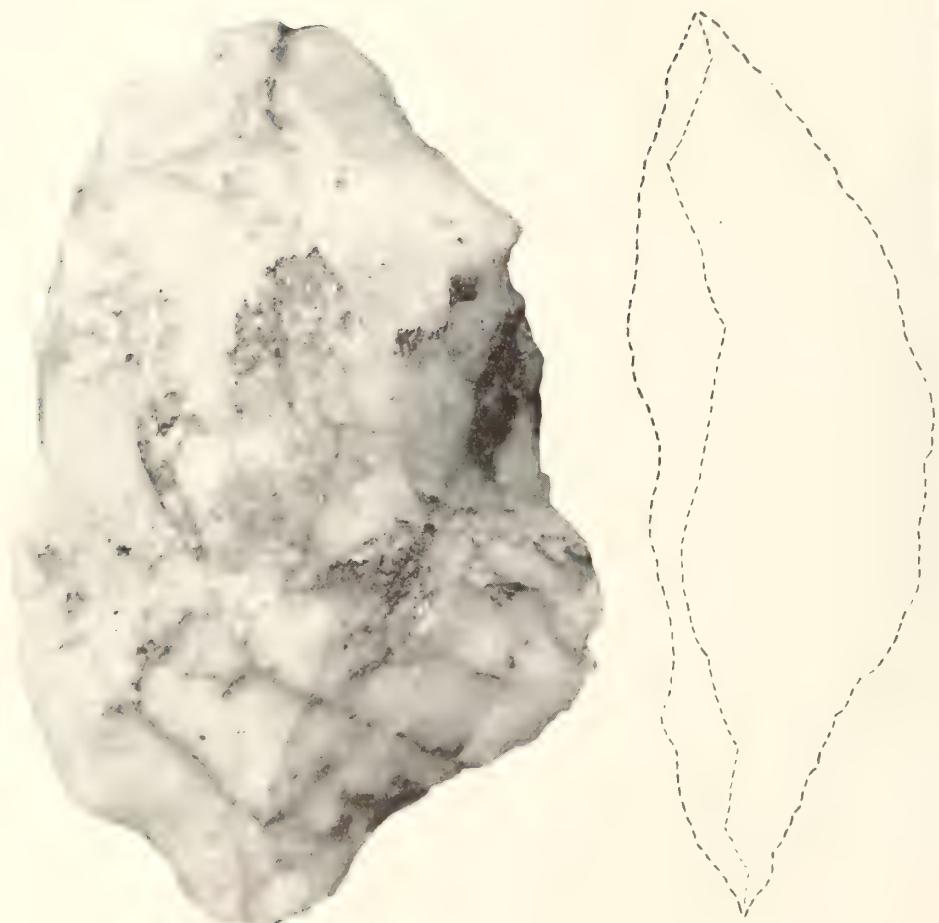
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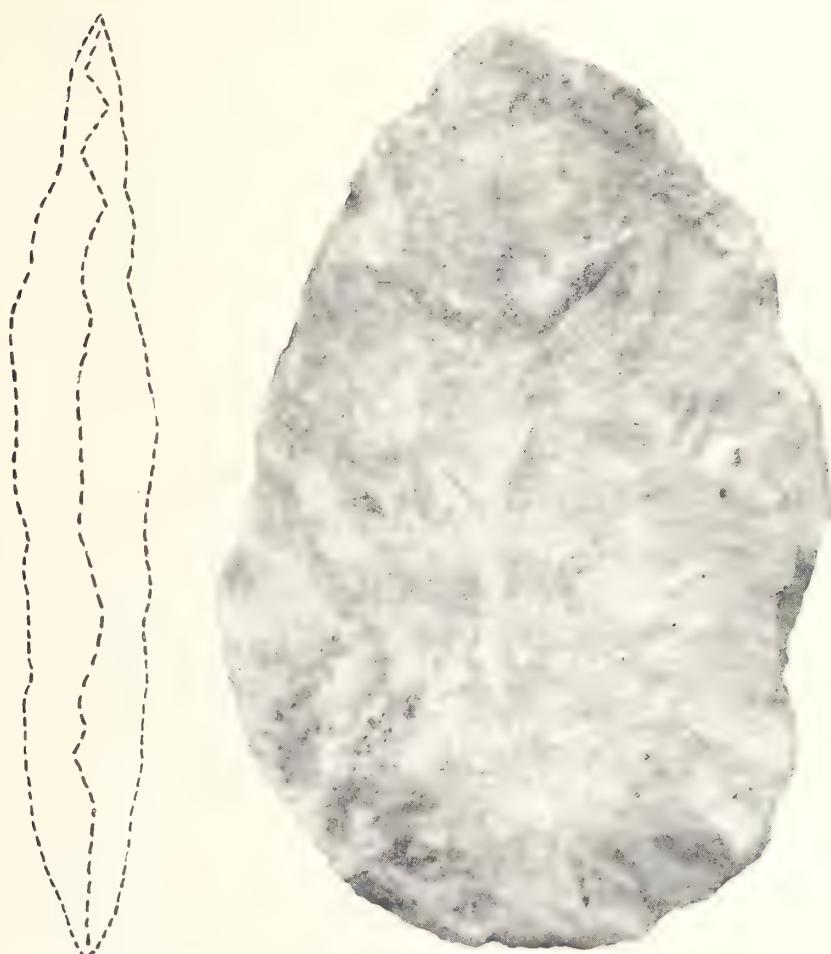
KAKABI KANSING. PLATE IV.



PALEOLITHIC QUARTZ BLADE. 1

From Glacial Gravel Beds at Little Falls, Minnesota.

KAKABIKANSING. PLATE V.



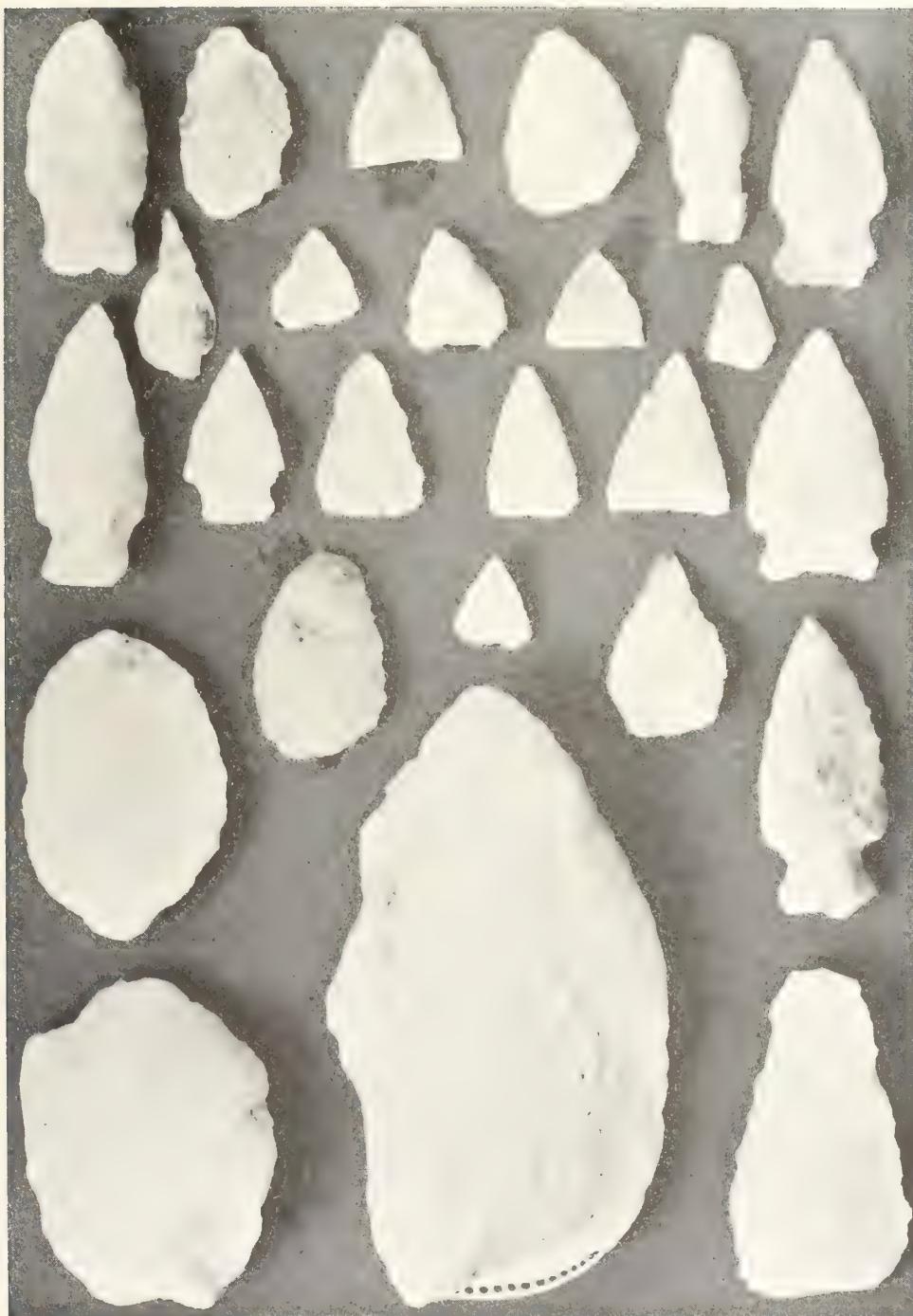
NEOLITHIC QUARTZ BLADE. $\frac{3}{4}$.

From a Mound Builder Village Site at Osakis Lake, Minnesota.



PALEOLITHIC QUARTZ BLADES. I.
LITTLE CEDAR CREEK, 16000' above sea level, Laramie River, Wyoming.
(Differentiation Plate.)

KAKABI KANSING. PLATE VII.



KATHIO QUARTZ BLADES AND POINTS. 1.

From Mound Builder Village Site near Little Falls, Minnesota.

(Differentiation Plate.)

KAKABIKANSING. PLATE VIII.



MUSEUM JAR NUMBER 1

Spec. Height 20 inches, circumference 15 inches, diameter 5 inches.

DESCRIPTIVE REFERENCE.

Museum jar No. 1, illustrated at Plate VIII, contains cobbles, pebbles, gravel and white quartz blades, chips and objects which were sifted from modified drift excavated at pit number 3, at the crest of an elevated sandbar formation which rests against quartz-veined slate at the east end of the dam across the Mississippi River at Little Falls, Minnesota.

The pit was perpendicularly excavated into the sand and gravel about eight feet and to a position in water-deposited materials which contain no quartz chips or blades.

The top of the jar contains siftings from the surface of the plain, and the bottom of the jar cobbles and pebbles from the lowest extremity of the pit. All intermediate siftings represent material taken from the pit with a sieve as the excavation was proceeded with.

No. 1 to No. 2, as labeled on the jar, illustrates siftings of cobbles, pebbles, gravel, white quartz blades and chips removed from the first four feet of the pit.

The cobbles, pebbles and gravel from No. 2 downward were sifted from the lower four feet of the pit.

All of the cobbles, pebbles and gravel taken from the entire pit are identically and exactly of the same character. They are materials from a water-deposited modified drift removed from coarse sand.

No potshard, arrowpoint or other neolithic artifact was sifted from the gravels of this pit.

Each pit excavated is fully described in the text of this address, so far as the same related to any characteristic test.



MUSEUM JAR NUMBER 2.

Size — Height, 15 inches; circumference, 13 inches; diameter, 4½ inches.

DESCRIPTIVE REFERENCE.

Museum jar No. 2, illustrated at Plate IX, contains sand, gravel, and 500 quartz blades and chips taken from the wall of an excavation on the south side of Broadway, at Block B, Mississippi addition to Little Falls, Minnesota.

The excavation was made to accommodate the construction of a blacksmith shop which was erected in 1901.

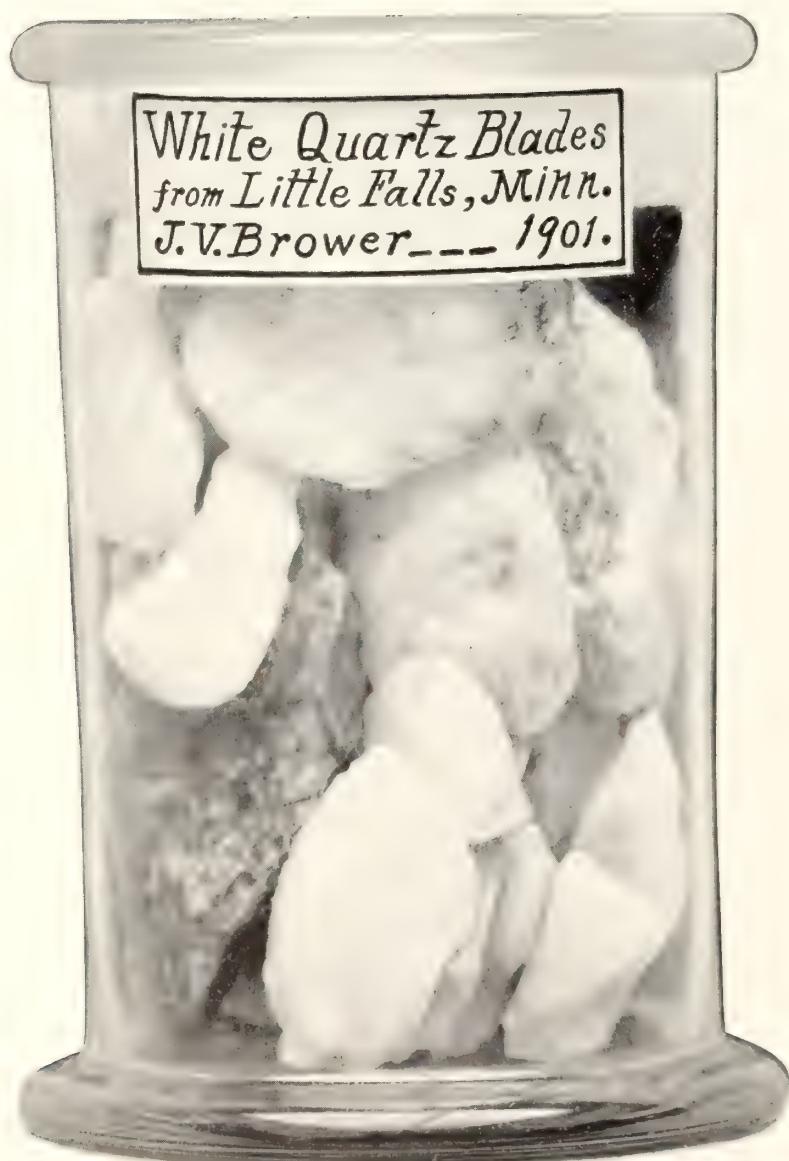
The contents of the jar represent the first two feet of the wall from the surface downward. The largest number of quartz objects were taken from water-deposited sand and gravel sixteen inches below the surface, and they were placed in the jar as excavated, which illustrates from the top of the jar downwards, the true position occupied by the quartz materials, comparable with a depth of two feet which the jar represents.

Professor N. H. Winchell, Mr. J. B. Chaney, Mr. Warren Upham, and the author of this *Memoir* were present at the time the contents of said jar were removed from the wall of the excavation, November 8, 1901. Many quartz objects were removed from the same excavation at a depth occurring from the surface downward a distance of three and one-half feet.

It has been ascertained that the gravel and sand taken from the excavation described, is modified drift deposited over the quartz objects by glacial currents, and that it occupied the same position when excavated that it did when deposited by running water.

An additional and very important fact was ascertained and determined, no less than a complete identification of the sand and gravel contained in said jar as materials which enter into the formation of the plain at Little Falls as an original glacial deposit of modified drift.

KAKABIKANSING. PLATE X.



MUSEUM JAR NUMBER 3.

Size. Height, 6 inches; circumference, 10 inches; diameter, $3\frac{1}{2}$ inches.

DESCRIPTIVE REFERENCE.

Museum jar No. 3, illustrated at Plate X, contains twenty-five chipped white quartz blades, recovered in 1901 from glacial gravel beds at Little Falls, Minnesota, with the exception of a dark colored, varnished quartz object deposited at the Peabody Museum by Miss Frances E. Babbitt, shown at the lower left hand space in the jar.

The chipped blades illustrated (except the Babbitt specimen), were recovered from positions where cobbles and pebbles abound in sufficient numbers to establish an identity irrevocably comparable with similar glacial materials at Little Falls, which emerged from till during a period of time when the dissolving ice-sheet caused a floodstage and tumultuous currents across the plain where the city of Little Falls is now located.

A portion of the blades were excavated from pits which perpendicularly penetrated the gravel beds, and from positions underlying waterworn and water-deposited cobbles.

The blades are distinctly unwaterworn, artificially chipped, of paleolithic origin, neither ground, stemmed, battered or prepared for hafting, and were not in contact or associated with any stone, flint, catlinite, chert, clay or other neolithic archaeologic materials.

Following pages of this *Memoir* will fully explain and completely demonstrate how, by whom, and when said quartz blades were deposited under an underlying modified drift of glacial origin.

KAKABIKANSING - PLATE XI



MUSEUM JAR NUMBER 1

Contains 1200 Quartz Chips from Gravel Beds at Little Falls, Minnesota

Size - Height 9 inches, circumference, 11 inches, diameter, 3 1/2 inches

KAKABIKANSING. PLATE XII.

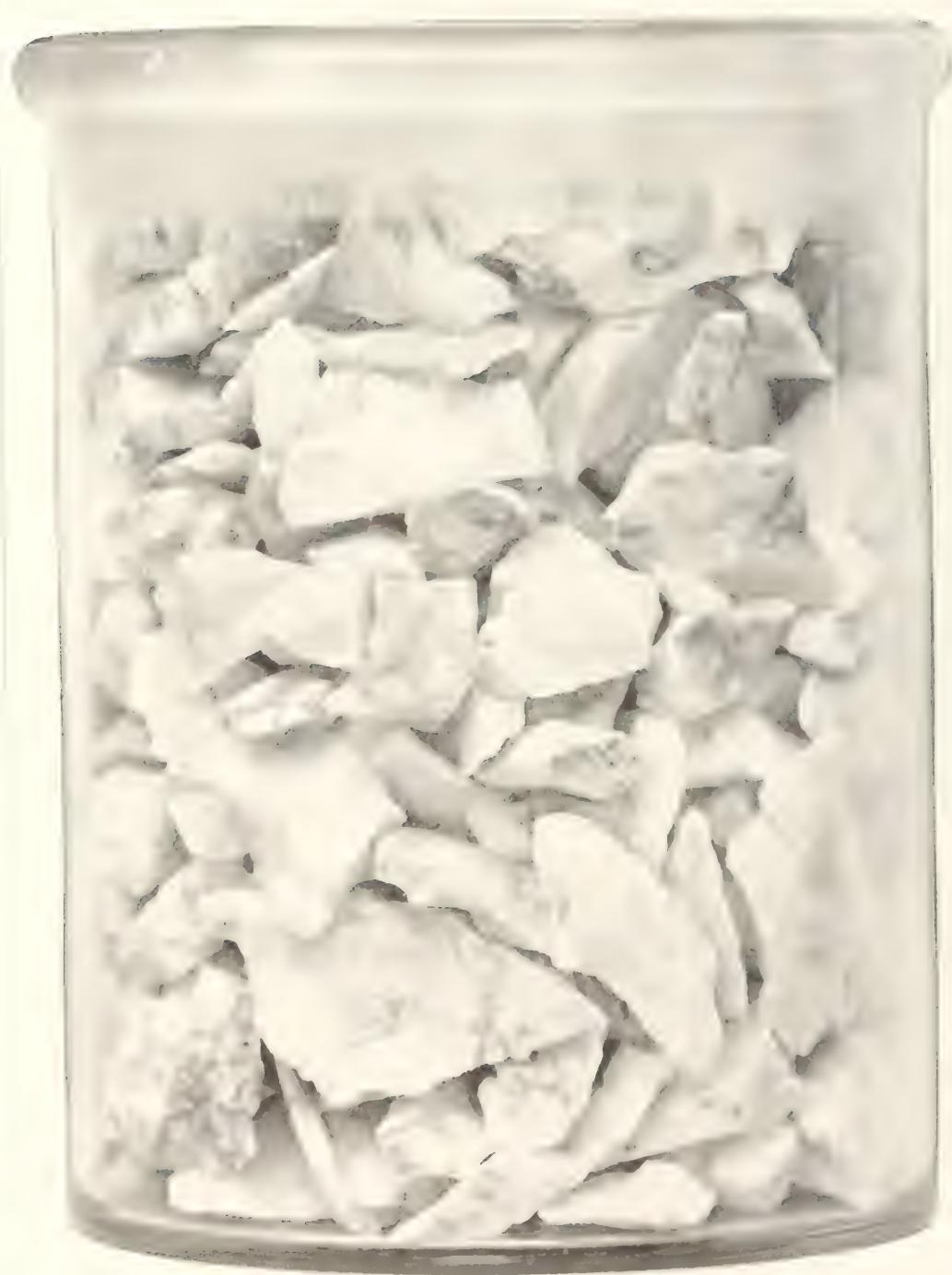


MUSEUM JAR NUMBER 5.

Contains 500 Quartz Objects from Gravel Beds at Little Falls, Minnesota.

Size: Height, 9 inches; circumference, 11 inches; diameter, 3½ inches.

KAKABIKASING - PLATE XVII



MUSEUM JAR NUMBER 6

Contains 200 quartz flakes and objects from Lake Falls, Minnesota.
Size - 11¹/2 by 8 inches, containing 18 flakes, diameter, 6 inches.

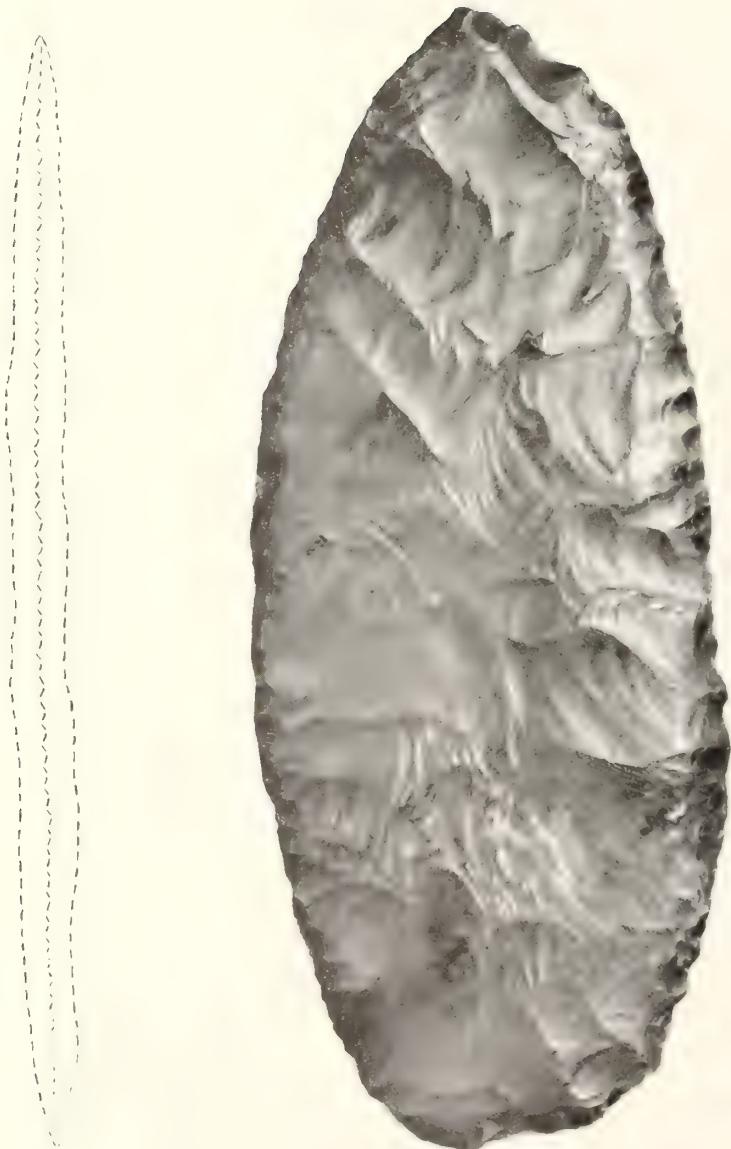
KAKABI KANSING. PLATE XIV.



MUSEUM JAR NUMBER 7.

Contains 50 Deteriorated Quartz Rejects from Little Falls, Minnesota.

Size: Height, 8 inches; circumference, 18 inches; diameter, 6 inches.



NEOLITHIC GUNFLINT KNIFE.

From Aitkin County, Minnesota.

KAKABIKANSING.

§ 1. BIBLIOGRAPHY.

AUTHORITIES AND REFERENCES RELATING TO THE PRINTED RECORD OF DISCOVERIES OF WHITE QUARTZ PALEOLITHIC IMPLEMENTS IN MINNESOTA, AND SUBSEQUENT DISCUSSIONS.

Little Falls, Minnesota, is a thriving city situated upon both banks of the Mississippi River about 107 miles northward from the city of St. Paul.

It derives its name from the precipitation of the waters of the Mississippi over a slate formation veined with white quartz. The descriptive expression—"Ka-ka-bi-kans-ing" ("The-place-of-the-little-squarely-cut-off-rock"), is the Ojibway designation which gave appropriate name to the locality. Translated, undoubtedly in somewhat abbreviated form, the permanent nomenclature has come into recent prominence as designating the seat of occupancy anciently available to the most primitive man known in the anthropologic history of the Upper Mississippi.

The identity of rudely formed chipped quartz blades and objects recovered from glacial gravels at Little Falls, has been brought into question. To more completely formulate a discussion of the true character of the chipped quartzes mentioned, it has been deemed advisable to first traverse the entire record of discovery and debate as it has been published, except, perhaps, in minor instances where there is an absence of additional information in recorded comments.

Several distinguished and competent authorities¹ have affirmed that

1. Cited, variously, at following pages of this *Memoir*, and quoted when necessary.

the quartz blades from the gravel beds of Little Falls are of very ancient origin, in fact were contemporaneous with the closing period of the glacial epoch; that they are artificially chipped, and therefore clearly indicate the former existence of a deliberative glacial inhabitant in the Basin of the Mississippi. The assertion has been strenuously opposed and emphatically denied, and as emphatically reasserted.

Some portions of the published record are consequently erroneous, and therefore properly subjects of consideration when made available as references during the time when a more complete review of the entire question is now attempted.

THE ORIGINAL AUTHORITY.

Winchell, Professor Newton H. *Geological and Natural History Survey of Minnesota. The Sixth Annual Report for the year 1877.* Pp. 50 to 65, both inclusive.

After the descriptive geology of Pike Rapids and of Little Falls had been stated in the *Report* by Professor Winchell, he entered upon a discussion concerning his discovery of Little Falls white quartz objects, at page 53, under a sub-head entitled:

PRIMITIVE MAN AT LITTLE FALLS.

The relation concisely states all the particulars of an important archaeologic discovery which has been the subject of protracted consideration, caused by an animated dispute concerning a correct classification of the quartz objects discovered. Professor Winchell cautiously hesitated to certainly identify the rude quartz objects he had described, contenting his unselfish purpose by a plain and entirely satisfactory statement of facts which induced him to consider the questions of the time, manner and circumstances which placed artificially chipped quartz objects in glacial gravels adjoining deposits of slate

containing quartz veins then forming the stream bed of the Mississippi at Little Falls, Minnesota.

The following quotations, taken from Professor Winchell's *Report*, are credited to the pages mentioned:

This quartz, which is white and opaque, was evidently taken from some vein in the slate in this neighborhood. * * * Subsequently, however, these [quartz] chips were found to extend over a larger area, and to be incorporated with the materials of the river banks. Further examination at Little Falls disclosed this interesting discovery. They are found, not only on the surface of the flat on which Little Falls village stands, especially near the river, but on excavating the bank near the river, making a perpendicular section, they are found to extend downward three or four feet into the sand and gravel. Page 54.

These [quartz] chips are all regular, some of them being as sharp as knives, and perfectly unwaterworn, and they occur in a waterworn deposit. * * *

The interest that centers in these chips, and which alone would warrant this extended account of them, involves the question of the age of man and his work in the Mississippi Valley.

The Mound Builders dwelt at Little Falls since the spreading of the material of the plain; hence they are post-glacial. The chipping race, if these chips are of human origin, preceded the spreading of the material of the plain, and must have been preglacial; since the plain was spread out by that flood-stage of the Mississippi river that existed during the prevalence of the ice period, or resulted from the dissolution of the glacial winter. Page 56.

A continuation of Professor Winchell's recorded observations which are perpetuated in his *Report*, indicates distinctly that he was conservatively but certainly inclined toward a belief that glacial man preceded the mound builder at Little Falls, Minnesota, and his discovery of white quartz, including chipped quartz objects and spalls, extended from Pike Rapids, on the Mississippi, to the mouth of Little Elk River, respectively four miles below and two miles above the slate deposits at Little Falls.

He further stated (p. 58) under a sub-head entitled "The Mound Builders" as follows:

Mention has already been made of ridges and mounds on the terrace at Little Falls attributable to the early race known as Mound Builders. They have a general resemblance to many others that may be seen in the state, some of which have been alluded to in former reports. Their occurrence at Little Falls is interesting especially in relation to the possible human origin of the quartz chips that have been described, as they seem to be of later date than the chips. This is proven by the fact that the mounds are built on the terrace plain, and of its materials, in the composition of which plain the quartz chips take part, extending three or four feet below the surface. * * * Further north is an interesting ridge, nearly straight, running obliquely back from the river and a hundred and eight paces in length. This is of a very different nature though plainly artificial.

The circular earthworks and the embankment described by Professor Winchell, were charted at page 59 of his report. Since that time an extensive lumber yard, mills, a railroad with sidetracks, an abutment to a wagon bridge, an adjoining railroad bridge across the Mississippi, sidewalks, streets, cellars, residences, barns and other buildings, all artificial extensions to the present city of Little Falls, have so con-

siderably modified and changed the surface of the natural plain where those aboriginal earthworks were located, that no attempt to restore or correctly chart them could or would be entirely successful at this time. The bank of the Mississippi nearest the location of the mounds and embankments has been extensively used as a railroad terminal for landing pine logs.

In his *Twenty-First Annual Report*, pp. 112-116, 1892, Professor Winchell resumed a discussion of his Little Falls geological studies and determinations.

MISS BABBITT'S EXPLORATIONS.

The next investigation at Little Falls concerning the quartz objects discovered by Professor Winchell, was undertaken by the late Miss Frances Eliza Babbitt,² in 1878, while engaged there as a teacher in the public schools.

Prompted by the previous discoveries made by Professor Winchell, in 1877, which she duly acknowledged in her published papers, Miss Babbitt first appeared in a public discussion of the Little Falls problem, at Macalester College, at St. Paul, Minn., February 2nd, 1880, when she presented an address before the Department of American History of the Minnesota Historical Society.

The address was published at length in the *Pioneer Press*, a newspaper, the following morning, and an extended extract therefrom was inserted in the *Little Falls Transcript*, February 13th, 1880.

From that address the following extract is reproduced:

It is a disputed point among American scientists whether the remains found from time to time along our river terraces, * * are referable to a post glacial folk or to co-glacial, inter-glacial or pre-glacial peoples. The gist of the difficulty lies largely in the scattering and accidental positions occupied by the remains in question when discovered.

It is easy to raise doubts in detail concerning the antiquity of a spearhead, a scraper, or an ancient hammer, or of a few bones picked up here and there, when, had the same objects been known to be essentially placed, that is, had they been found clearly occupying the positions in which they were placed by the races originating them, the question of their real character would not be open to discussion at all. The Little Falls quartz workings undeniably occupy just such a place, and to this fact they owe a importance which is no doubt destined to make them the object of national study.

Miss Babbitt continued her investigations and studies at Little Falls, and at the August 15th, 1883, XXXII meeting of the American Association for the Advancement of Science, at Minneapolis, Minn.,

2. Born January 24th, 1824; died July 6th, 1891.

presented her second address concerning Professor Winchell's discovery, which constituted an elaboration of her own observations.

An abstract of that paper appears at pp. 385-390, *Proceedings of the A. A. A. S.*, 1883, and a collection of the quartzes which was exhibited at the Minneapolis meeting was deposited in the Peabody Museum, at Cambridge, Mass., as a partial result of her explorations which were principally directed toward a determination of the true character of quartz objects and implements recovered from a sand and gravel bank slightly overspread with alluvium bearing a scattered



THE LATE MISS FRANCES ELIZA BABBITT.

growth of small, deciduous trees which bordered the Mississippi River about 2,000 feet northward from the slate and quartz deposits which form the river bed at Little Falls, Minn. She named the very limited locality which attracted her greatest attention, "The Notch," descriptive of an aspect exemplified by a roadway and trail which obliquely descended from a level plain upon which the city of Little Falls stands to the floodplain of the Mississippi on the east side of the river about twenty-five feet below the natural level of the adjoining surface.

Miss Babbitt placed herself in communication with several scholarly scientists among whom was Professor F. W. Putnam, curator of the

Peabody Museum, and she accepted and incorporated as a part of a paper entitled "*Vestiges of Glacial Man in Minnesota*" (*American Naturalist*, June and July, 1884, issues), a geologic description of the Little Falls region prepared by Mr. Warren Upham. Her investigations, and her papers, were carefully and slowly proceeded with, until the results were accorded the favorable approval of several scientists whom she had consulted.

The collection of quartz objects gathered by Miss Babbitt, which she advisedly classed as paleolithic implements artificially shaped by glacial man, came principally from "The Notch," which she denominated "a cache," established when man and the process of the formation of the gravel beds at Little Falls were in contemporaneous existence.

In the *Naturalist* for July, 1884, p. 704, she said:

The quartz-working people flourished at a day when the upper division of the terrace-plain had not yet been spread out. * * The study here commenced is henceforth to be pursued along two distinct lines of investigation; one comprehending the drift surfaces of the region, the other the objects exhumed. (Pages 704-5, July, 1884, *Naturalist*.)

The Babbitt collection of quartz material, said to have been a complete representation composed of several thousand pieces, spalls, chips, blades and implements, which she preserved at Little Falls, was destroyed by direction of a relative with whom it had been placed previous to Miss Babbitt's death.

A few months later the relative also died, leaving no information concerning the Babbitt collection of quartz implements, and there exists very little hope that any portion of the same can be recovered and identified, except the limited number at the Peabody Museum, and a few of the specimens held at St. Paul and elsewhere.

Some immaterial errors of distances occur in Miss Babbitt's papers relating to the position of "The Notch" when referably described in connection with the falls. Upon a careful perusal of all her papers, after much study and comparison with geologic and hydrographic data obtained recently at Little Falls, it must be concluded that a sliding material which forms the river bank at "The Notch" at Little Falls, subject to occasional disturbance, cannot be depended upon as yielding the best evidence concerning exact occurrences which took place before the present bed of the Mississippi was channeled at that

KAKABIKANSING. PLATE XV.



CHARACTERISTIC QUARTZ OBJECTS. 1.

The five specimens were obtained from "The Notch" by Miss Frances E. Babbitt, at Little Falls, Minnesota, and by her transmitted to Boston, Mass., whence a photograph of them was obtained from Professor Henry W. Haynes, and the above engraving first appeared at page 15, *Missouri River*, 1897.

place. At the close of her engagements at Little Falls, Miss Babbitt retired to her former home in Michigan, leaving a record of her investigations which has everywhere attracted the attention of ethnologic students. Her papers, covering many printed pages, are too voluminous for reproduction at this time. Undoubtedly her essay appearing in the *Naturalist*, June and July, 1884, can be depended upon as perpetuating her most mature and deliberate study.

There is an abstract of an additional essay as follows:

[Proceedings of the A. A. A. S., Vol. XXXIII, Philadelphia meeting, September, 1884.] *Exhibition and Description of some Paleolithic Quartz Implements from Central Minnesota.*

This paper describes the Little Falls quartz implements exhibited at the Philadelphia meeting.

To completely understand the contents of this paper, it was arranged to exhibit the specimens by groups and numbers, and the following note will be found at page 593 of the *Proceedings*:

The specimens exhibited before the section are now in the Peabody Museum at Cambridge, Mass., where they can be seen by any one interested.

Miss Babbitt's concluding paper appears to have been prepared at Coldwater, Mich., and is entitled:

Points Concerning the Little Falls Quartzes, Vol. XXXVIII, 1889,
pp. 333-339, *Proceedings of the A. A. A. S.*

[Abstract.]

A point fundamental to any fruitful study at large of these objects is the essential one: Are they genuine palaeoliths? The inquiry formulates a dual problem in origins—origin as to agency, and origin as to time. Leaving out of the account the minor differentiations nascent in American palaeolithics, the general question involves, in the present case, these two: Were the Little Falls quartzes shaped by man? Were they produced prior to the close of the last glacial epoch? The two inquiries naturally address themselves to two distinct departments of science, namely, archaeology and geology.

In accordance with this view of the matter, and at the suggestion of the state geologist of Minnesota, the quartzes indicated were early submitted to authorities upon the primal productions of the human race, for an ultimate decision as to their artificial character. The subject of their relative antiquity was meantime referred to specialists in the quaternary geology of the region. Parcels of specimens have found their way at different times to various scientific institutions, and have likewise been supplied, for purposes of study and comparison, to distinguished archeological experts, as to Dr. Charles Rau, to Dr. C. C. Abbott, and to Professors Haynes, Putnam and Mason.³

With the exception of Dr. Rau, deceased, whose final conclusions were not communicated to me, the authorities named concur, as I have been assured, in declaring these quartzes to be the unmistakable product of intention; either as chips struck off in the process of manufacture, or as imperfect or finished implements. Certain of the latter have been identified with well known types, their assimilation to which is regarded as essential and not fortuitous, and as indicating that the widely scattered palaeoliths of this continent and the other had a common *raison d'être*. Let it be understood, therefore, that the artificial character of the

³ Dr. Rau turned over to the Smithsonian Institute the specimens forwarded for his inspection; Dr. C. C. Abbott placed those in his keeping in the Peabody Museum of American Archaeology. The objects exhibited before section H, of the A. A. A. S. at its Minneapolis and Philadelphia meetings of 1883 and 1884, together with others forwarded for examination by Professor Haynes, have been consigned to the same institution.

specimens in hand is not established upon my own personal *ipse dixit*, nor that of any other individual, but upon the unanimous verdict of qualified scientists of international repute. As these authorities are equipped with special facilities for comparison, and have an intimate acquaintance with objects of the class discussed, there appears to be no sound reason for distrusting their matured opinion. Professor Putnam has, at different times, brought typical specimens of these objects before the Boston Society of Natural History for general examination and comparison with other palaeolithic implements, American and foreign. In the proceedings of this society for the present year, pages 164-5, he presents figures of Little Falls quartzes, of which he says:—"Others of these before you are identical in shape as well as material with the specimens obtained by Dr. Abbott from the Trenton gravel, and certainly their artificial character will not be questioned." Professor Haynes, in the chapter on Prehistoric Archaeology of North America, in Vol I of Winsor's *Narrative and Critical History of America*, expresses a like opinion, formed upon a study of numerous specimens that have been submitted to him, but not the same as those upon which Professor Putnam has based his conclusions.

THE RICHARDSON HISTORY.

Hon. Nathan Richardson, who has resided at Little Falls almost fifty years, has performed a public service of especial interest in writing a local history of Morrison County, Minn.

By order of the County Commissioners the Richardson papers were published in *The Little Falls Transcript*, a local newspaper, in 1880, commencing with a February number and continuing until the autumn of that year, when the only published history of Morrison County was considered finished, although only in newspaper form.

The Babbitt investigations and the Richardson history were contemporaneous, and inasmuch as there are certain references in Mr. Richardson's papers which record and perpetuate interesting facts relating to some material occurrences in the history of Little Falls, the following quotations are republished verbatim:

HISTORY OF MORRISON COUNTY.

Professor N. H. Winchell, our State Geologist, came to the conclusion, when he made his geological examination of this county in the summer of 1878, that a large number of people were here previous to the last glacial period, which period, in point of time, has never, to my knowledge, been even approximately fixed; but to say the least it was a great many thousand years ago. In his geological reports he gives his reasons fully for arriving at that conclusion, the principal reason being the large quantity of quartz chipping found mixed up with the last layer of sand along the banks of the Mississippi river, which is four or five feet deep in some places. At that time all their edged tools were apparently made of stone, and the white quartz rock found in abundance in this locality is the best stone that can be found for bringing to, or making, a sharp edge by breaking or chipping off. As his theory appears to be a good one I think it is correct; and as there is a large amount of these chippings here, it indicates that there was a large population in the country at that time. Coming down, then, to a time after the glacial period, the mound builders inhabited this section of country. * * * In the immediate vicinity of Little Falls no mounds appear, but about fifty rods north of the townsite there is a ridge apparently as old as the mounds. The northwest end comes near the main road, and it runs from thence back nearly parallel with the Mississippi river about 110 yards. Its height is about four feet. Some other ridges appear in the vicinity, but are quite insignificant in comparison with this one. Whether these were made for the purpose of burying their dead, or for defense, is not known, as they have not been examined by digging into them.

On the top of the east bank of the Mississippi river, and about two rods from the edge, there are a dozen pits situated about three rods apart, which were apparently made at a very recent date. They were originally dug to the depth of about three feet, and about twelve feet square. * * An Indian who claims to have been present when they were made makes the following statement:

They were dug in about the year 1835, on an occasion when a heavy battle was expected with the Sioux Indians, who had collected in large numbers on the high ground back of Little Falls, while the Chippewas

(However) situated on the Mississippi river bank, at the same time I beg to present these facts as submitted to *Transcript*, Feb. 6, 1880.

Some time ago I made a collection of the mounds and quartz chippings found in this locality, and do not well remember so much as further concerning those matters. About a year since Miss Frances H. Babbitt came to reside in Little Falls, and it so happens that she has long been an enthusiastic student of geology and archaeology. Since her sojourn in Little Falls she has worked faithfully in at least trying to solve the quartz chipping problem that presents itself at this place to an observing mind. She has already gathered, principally along the banks of the Mississippi, about 1,200 specimens of rock, quartz chippings, etc., varying from the size of a finger nail to three or four pounds in weight, nearly all of which she has labeled and sent to different geological and scientific institutions in the Eastern States. She often observes that these quartz chippings are as there are all of human origin and were shaped by the hand of savage or uncivilized people who inhabited this country in the inter-glacial period, a long time previous to the time when the mound builders resided here. Miss Babbitt explains, or attempts at least to explain, the use that was or could have been made of each piece she has gathered; and I judge from the communications she has received from scientists, and from works by different authors on the subject I have read, that the weight of authority favors her theory; but after examining the question as fully as I think of any use, I am inclined to the opinion that this quartz rock was crushed and mixed up with the earth along the banks of the river at this place by some other than human agency. Other rocks are frequently found crushed and mixed up with the broken quartz rocks, which show no special design as to shape. If Miss Babbitt's theory is the correct one, Little Falls in those days was a great manufacturing point, and the hardware merchants must have kept a good supply of stoneware on hand. Arrowheads and other stone implements are occasionally found about this country, but I never saw one that was clearly made by man that was made of the same sort of white quartz as those chippings which are so abundant in this locality. During the past year several small pieces of ancient pottery have been picked up in the plowed field on the west bank of the Mississippi, at the ferry, about a half mile above the falls, and nearly opposite to the earthworks on the east side of the river before mentioned. *Transcript*, July 23, 1880.

RELATION OF UPHAM.

Mr. Warren Upham, distinguished as a glacial geologist, and author of numerous essays and addresses upon scientific questions, examined the geology of Little Falls, Minn., in 1880 and 1881, while representing the Geological and Natural History Survey of Minnesota.

The published report of that labor appears as Chapter XXII, Vol. II, *Geology of Minnesota*. At page 610 there is a general discussion concerning the quartz blades and chips discovered there by Professor Winchell. Later, in 1883, Mr. Upham assisted Miss Babbitt in the preparation and presentation of her paper at the Minneapolis meeting of the A. A. A. S., afterward contributing geological data which Miss Babbitt incorporated in her essay at pages 706-8 of the July, 1884, *American Naturalist*. Mr. Upham has so continuously considered anthropologic questions in connection with the disappearance of the ice-sheet in Europe and America, even to the extent of visiting the Somme Valley, France, for the purpose of studying the glacial gravels and paleoliths characterizing that region, that he has been requested, and has consented to prepare a list of authorities on that question for the pages of this *Memoir*, so far as it pertains to glacial man in America, which arrangement curtails this bibliographic section to a

consideration of the printed results of actual explorations in the field at Little Falls.

At page 363, Vol. XIII, *American Geologist*, there is a communication from Mr. Upham entitled:

EARLY MAN IN MINNESOTA.

The article is in reply to Professor W. H. Holmes' *Vestiges of Early Man in Minnesota*, appearing in *The Archaeologist* for March, 1894, modified from the original publication in the *American Geologist* for April, 1893.

In that communication Mr. Upham in part says:

Having again attentively read [Miss Babbitt's] statements of the conditions of this most plentifully quartz-bearing bed of the modified drift at Little Falls, with its occasional grouping of numerous quartz fragments of similar forms, or of like lithologic character, apart in small hoards or places of assortment, I still believe that men making stone implements were here while the modified drift was being deposited. Nor was this geologically long ago, for Prof. N. H. Winchell's well-known studies of the recession of the Falls of St. Anthony from Fort Snelling to Minneapolis indicate that the time since the departure of the ice-sheet from Minnesota has been probably between 6,000 and 9,000 years, his average from three estimates being 7,800 years.

Owing to some recent observations, there now appears to be need for a study of altitudes above the sea level in connection with the formation of the extensive river terrace laid down where the city of Little Falls is now situated, by the great glacial river which formed the gravel beds where the quartz objects are profusely involved. Mr. Upham has variously determined the elevations of Morrison County, and they are now particularly convenient and valuable.

HILL-LEWIS EXPLORATIONS.

The late Alfred J. Hill, several years after the discoveries of Professor Winchell and Miss Babbitt had been made known, caused the Little Falls locality to be explored. The unfortunate scattering and waste which overtook his papers and data, after his death in 1895, places the information he obtained in an unavailable condition except so far as appears in *The American Antiquarian* for March, 1887, in an article entitled "Quartz-Workers of Little Falls," signed by the archaeologist whom Mr. Hill sent to Little Falls to conduct the explorations.

The only known results which have been perpetuated concerning the Little Falls quartzes, by the Hill-Lewis explorations, are contained

in the article quoted, which are so considerably meager that they seem to have heretofore escaped notice. Mr. Hill was a scholarly scientist of rare ability, a fluent writer, and a student of anthropology whose archaeologic labors have not received the attention they deserve.

In the article quoted the following declaration is made:

At the mill in the upper part of town, where there is a perpendicular cut through this layer of sand, the quartz chips extend downwards to the depth of from three to five feet. These have undoubtedly worked down from the surface in the course of time.

The opportunity to fully determine the true character of the Little Falls quartz chips and spalls was optional with Mr. Hill at that time, and it is a misfortune that he did not approach the results of the discoveries made by Professor Winchell with any considerable faith, or a willingness to concede importance and extend credit.

INVESTIGATIONS BY PROFESSOR HOLMES.

Professor W. H. Holmes, now Head Curator of Anthropology of the United States National Museum, in June, 1892, representing at that time the Bureau of American Ethnology, proceeded to Little Falls, Minn., and instituted a careful and laborious investigation concerning the identity and character of quartz objects involved in glacial gravels at and about the falls.

Professor N. H. Winchell, the original discoverer of the Little Falls quartzes, united with Professor Holmes in the investigation, but he did not join in the published accounts of the explorations.

Professor Holmes explored both banks of the Mississippi at and about Little Falls, and prosecuted a painstaking and careful investigation of "The Notch," where Miss Babbitt had previously observed and gathered the greatest number of quartz objects described in her papers; but at the date of the Holmes investigation, "The Notch" was, and is now, flooded with back-water about half way up the distance between the terrace plain, upon which the city of Little Falls now stands, and the recent flood plain of the Mississippi, situated at the lowest extremity of "The Notch." The flooding at that place is caused by the back-water above the extensive mill dam across the Mississippi

about 2,000 feet down the river from the place where "The Notch" ended at the recent and lower flood plain of the Mississippi.

Mr. Holmes trenched, and excavated pits, at the upper portion of "The Notch," discovering tree roots in the gravel beds where, in case of windstorms or tornadoes, the leveling of the forest by a sudden convulsion would precipitate quartz objects which were on the surface at the foot of the trees, into the cavities created by a leveling of the forest; hence, by natural forces, the quartz chips and objects placed on the surface of the ground about the tree-roots by Indians would be involved in glacial gravels as a natural result of the leveling of the forest by the forces of nature. He handsomely illustrated the theoretical and suggestive proposition by a series of figures showing the several stages of artificial and natural action that would carry the quartz refuse left on the surface of the ground under the trees into the pits precipitated by the uprooted forest, which, leveled by the lapse of time, would leave the gravel beds and quartz objects intermixed into one common mass to a depth below the surface measured by the "hollows after the rotting of [the] uprooted trees."

The illustrations presented by Professor Holmes are available for comparison in an article entitled:

Vestiges of Early Man in Minnesota, *American Geologist*, Vol. XI, pp. 219-240, 1893.

From that publication the following extracts are quoted:

It is clear that the section exposed by my trench discloses exactly the conditions and phenomena that would result from the occupation of the site by quartz-workers of our neolithic aborigines at any period subsequent to the exposures of the Huronian bed rock by the post-glacial river, and there is nothing in the conditions and phenomena of the site that will enable us to say whether the beginning of the quartz-working dates back one hundred or one thousand years. Considering all phases of the evidence, however, geologic, topographic, archaeologic and historic, the probabilities are very strong that the former figure is more nearly correct than the latter. * * * * I have shown that the presence of worked quartzes in the unstratified, superficial loams furnishes no real support for the theory of a glacial man. In the study of this site, three problems have come up for consideration: first, is there evidence of human occupation of this locality early in the gravel-forming era as deduced by Miss Babbitt from the discovery of worked quartzes along the base of the terrace? Second, is there evidence of man's presence at the close of the glacial epoch, as indicated by art forms distributed through the surface loams? and third, is there evidence that the art or any part of the art attributed to these horizons is paleolithic? All of these questions may be answered emphatically in the negative. * * * *

In closing it may be stated with entire confidence that there is no available evidence of either a paleolithic man or glacial man in any part of the upper Mississippi valley. So far as my own observations and interpretations go, the vestiges of early man in Minnesota are confined exclusively to ordinary traces of Indian occupation.

The continued study which Professor Holmes has extended toward this and similar questions has resulted in causing more accurate and

less hasty conclusions to be formulated on the basis of carefully ascertained facts. His position in the Little Falls quartz discussion, based on his own explorations and observations, has compelled, and very properly so, a more extended discussion than the question would now receive in the absence of his conclusions; and all concerned in a correct interpretation of the facts can certainly acquiesce in the attempt to develop the complicated study, whether the conclusions are or are not accepted.

HERSHEY'S OBSERVATIONS.

In September, 1896, Mr. Oscar H. Hershey engaged in what he termed "a desultory investigation" into the distribution and character of quartz fragments of Morrison County, Minn.

Under the title: *Archæological Notes on Central Minnesota*, his views concerning the quartz question at and near Little Falls were published in *The American Geologist* for November, 1899, pp. 283-294, Vol. XXIV.

Mr. Hershey seems to have made a very careful examination of the Little Falls region, concisely and correctly describing many of the natural and hydrographic features of the Mississippi, and geologic conditions which characterize adjoining uplands and river terraces.

At page 289 Mr. Hershey said:

A visit was made to the "Notch" the site of Miss Babcock's most important discoveries. It is almost gone in recent years and no longer constitutes a satisfactory field of research. * * * It is a ravine having been greatly disturbed in recent years, probably by Dr. Holmes' workmen in digging a ditch in 1892. No ditch is visible at present, as its banks have crumbled away. The bottom of the ravine is submerged and covered with logs.

There is in Mr. Hershey's paper the distinct intimation that there exists a palpable difference in character between the quartz chips found along the flood-plain of the Mississippi and those involved in glacial gravels, altitudes and position indicating the differentiation. This fact seems to have escaped the notice of other investigators. Its importance requires very careful and attentive consideration, and will be fully explained as one of the results of my own observations, made at a

time when the entire region was being subjected to an extended archaeologic exploration.

His proposition at page 292 that "while the upper five feet of the Glacial flood-plain was under formation, not one of the quartz veins in this [Morrison] county was above the stream-bed," is a very uncertain statement. The slate formation in place is now above the surface of the water in the Mississippi at the crest of the mill-dam. That slate contains the quartz deposits, and it is not now the indisputable province of any observer to correctly determine the altitude of the crest of the slate formation at the time the gravels and sand were being deposited by the floods of a great glacial and tumultuous river, except approximately, and then only with great care and caution.

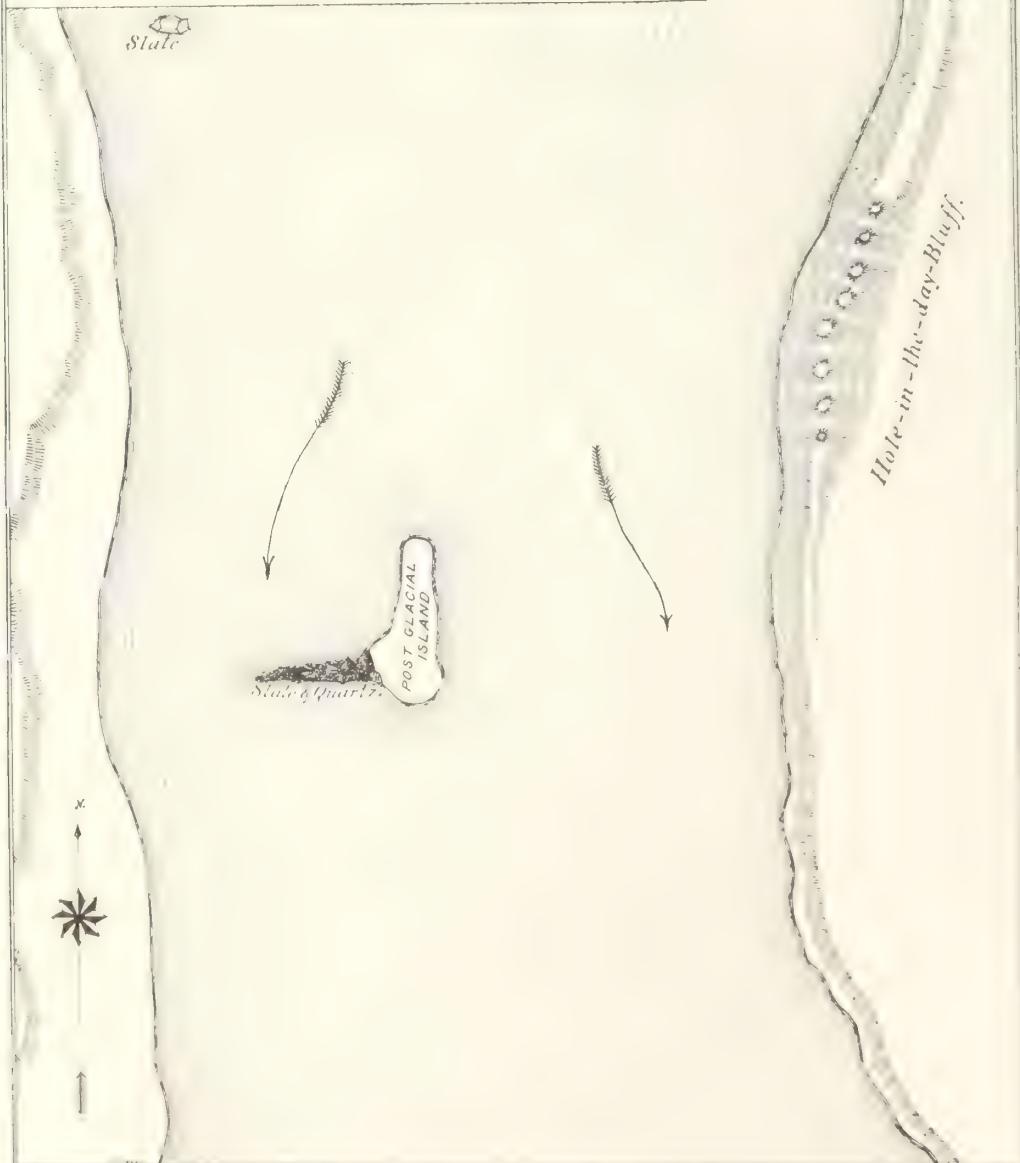
Professor Winchell inclines to the opinion that some portion of the slate formation containing quartz was at or above the surface of the glacial stream when the upper portion of the sand-plain was finally deposited; and as indications are there present that such was the fact, it can be more fully discussed as an important subject in a succeeding section of this *Memoir*.

While Mr. Hershey inclines to the theory of tree-roots influencing the deposits of quartz chips beneath the surface of the sand-plain, there is no explanation in his paper to account for the chips and implements which have been recovered from glacial gravels on a level plain which bears no indication whatsoever of the presence of a forest, a tree, or a tree-root.

He believes that all of the quartz chips originated at a post-glacial period "while the Mississippi flowed at nearly or quite its present level."

CHART OF THE
MISSISSIPPI RIVER
at the
Closing period of the Glacial Epoch,
where
Little Falls, Minnesota,
is now situated.

Drawn from field notes
by
J.V.Brower.
1902.



§ 2. EXPLORATIONS.

HYDROGRAPHIC, GEOLOGIC AND TOPOGRAPHIC FEATURES OF THE MINNESOTA REGION SURROUNDING THE KAKABIKANSING QUARTZ DEPOSITS AT LITTLE FALLS, AS THEY APPEAR TO HAVE INFLUENCED THE DESIGNS, PURPOSES AND EXISTENCE OF PRIMITIVE AND ANCIENT RACES OF MEN AT THEIR CAMPING GROUNDS, WORKSHOPS AND VILLAGE SITES ON THE UPPER MISSISSIPPI.

The author of this *Memoir* has had occasion to observe nearly all of the numerous conditions which characterize the natural features of the region at and about the headwaters of the Mississippi and adjacent localities for a period of forty-two years.

During that time a very careful study of the character, habits and customs of Indian tribes and bands inhabiting the Northwest, has attracted unusual interest and attention. A particular series of observations has also been conducted during many seasons of exploration for the purpose of determining hydrographic and topographic facts; and a study of geologic formations has been most agreeably and fortunately augmented by the advice and counsel of scholarly scientists who have been foremost in determining the geology of Minnesota and other localities. Meanwhile archaeology has received sufficient attention to considerably develop a better knowledge of the ancient mound-building people and their habitats, customs, arts and identity, from Itasca Lake to Kathio and St. Paul, and from Lake Superior westward to the sources of the Missouri, and elsewhere.

I do not presume to assume any greater efficiency than is enjoyed by hundreds of other investigators; indeed their stores of knowledge have been drawn upon for great comforts and benefit while endeavoring to unravel difficult problems, and hence it is well to understand and

admit how very defective this labor would be without a knowledge of developed and determined facts which have been perpetuated by other students. Likewise their errors, and some of my own, unwittingly committed by publishing statements too hastily written and inadvertently determined, compel a cautious approach toward the most difficult problem in the history of anthropologic researches in the Basin of the Mississippi—Glacial man.

In taking up a study of the conditions surrounding the quartzes of Kakabikansing, the earliest known feature is considered first, and thence, by progressive arrangement, the entire field of observation can be traversed as briefly as circumstances will permit.

During the time of the explorations at Little Falls Professor N. H. Winchell was present two days, Mr. Warren Upham one day, and Mr. J. B. Chaney six days. My own time basis while engaged at Little Falls, during the year 1901, is as follows:

April 13th and 14th.....	2 days.
June 4th and 5th.....	2 days.
June 18th and 19th.....	2 days.
October 12th and 13th.....	2 days.
November 4th to 9th, both inclusive.....	6 days.
November 18th.....	1 day.
December 10th and 11th.....	2 days.
 Total.....	 17 days.

Professor N. H. Winchell was fortunately able to discover and determine the character of a greenstone formation which outcrops at Randall, Morrison County, Minnesota, as undoubtedly a portion of the igneous rock which may have formed in part an Archaean encrustment of the cooling earth. He also described the quartz-veined slate at Little Falls and Pike Rapids as mica schist, a metamorphic transformation of rocks similar to the greenstones. The granites, in conspicuous outcrops east of Little Falls, he places third in age, and possibly fourth a marble-like layer of limestone at Pike Rapids, the Cretaceous beds near the mouths of Two Rivers forming the youngest rock in the county. Those rock formations of Morrison County,

consequently, create the basis for a very complicated geologic study, reaching far back into the history of the past so many thousands of centuries that the lapse of time cannot be numbered by years.

Native silica by the process of aqueous infiltration was deposited in the cavities and fissures formed by strains and faults of the slate rocks, and the mineral can at present be quarried in considerable quantities below the dam at Little Falls, where it forms veins of white quartz, in places tinged with a bluish tint, and invariably bearing a dark-colored sedimentary cast where it occurs in direct contact with the slate. There are also veins of white quartz in the slate formation at Pike Rapids, and near the mouth of Little Elk River, which is about two miles above the dam, but the quartz at the last mentioned place as now exposed is brecciated and limited in quantity.

Professor Warren Upham, the distinguished glacial geologist, has from time to time since his first examination at Little Falls, ably discussed the causes, continuance, halts, readvances, and final disappearance of the great North American ice-sheet which enveloped the region about Little Falls to the depth of a half or possibly three-fourths of a mile for many thousands of years, grinding and crushing the surface material into the drift which now considerably covers nearly all of Minnesota, except where rock formations are exposed. When the ice-sheet was gradually disappearing from the effects of a moderated temperature, the quantities of water which were discharged upon the surface modified the drift in many places and gradually formed the Mississippi River between Fort Snelling and Itasca Lake. Mr. Upham's published writings can be appealed to for detailed information concerning the natural occurrences which prevailed before the appearance of man at Little Falls. Any complete discussion concerning those events cannot now be entertained, for want of necessary space.

A great glacial river poured its tumultuous current down through the region between Aitkin County and the mouth of the Minnesota River, forming by a water-deposited plain of sand and gravel, nearly level in its general character, a long and broad glacial river-

bed bordered by morainic or kame-like hills on either side. That river-bed was from two to six or more miles in width, and over two hundred miles long. The banks of that ancient river at Little Falls are now visible at Hole-in-the-day Bluffs and the hills first westward from the mouth of Little Elk River, all within sight from an unobstructed view at Kakabikansing. During the continuance of the



ANOTHER SUGGESTION.

Possible appearance of a great tumultuous glacial river plunging its floods against the quartz-veined slate formation at Kakabikansing.

flowage of that great river, arctic or temperate weather prevailed according to the vicissitudes of climatic events. There can be no reasonable doubt that that river had seasonable stages of high and low flowage, and that it was from time to time closed with a solid covering of newly formed ice. Immediately north of Little Falls the ancient river-bed included what is now called Belle Prairie, and south therefrom, Langola Prairie, North Prairie, Winnebago Prairie, and the

sandy prairies reaching along the Mississippi through Sherburne, Anoka and Hennepin counties, united, constitute almost a continuous stretch of prairie from Crow Wing to Minneapolis, bordered by timbered hills, forming a sandy and gravelly water-deposited and nearly flat plain with modified drift which fairly outlines the limits of the width of the Upper Mississippi at that time. Practically all of the trees along or scattered about those prairies are diminutive, and it can be safely suggested that no forests mature there on account of the parched condition of the sandy plain repeatedly occurring during summer seasons. The adjoining hills are generally, often generously, covered with a forest growth. From Belle Prairie southward past the present site of Little Falls, to Watab, there are no indications that any considerable forest ever existed along the east side of the Mississippi.

There are five successive altitudes which bear directly upon the question under consideration, as follows:

Elevation of morainic hills at Little Falls, altitudes of the plain, the lower positions of more recently formed river terraces, the present flood-plains of the Mississippi, and the present bed of the river littered with slate and quartz detrital masses, gravel and sand.

It is a very significant fact of inestimable importance that the altitude of the plain upon which the city of Little Falls is situated is highest at the place near the east end of the falls where the largest number of quartz chips have been observed. The present bed of the Mississippi is west from that particular location. When the great glacial river by reason of meteorologic conditions while discharging its flood was overtaken by a season of decrease in the water-flowage during the last stages of the melting ice-sheet, then from sixty to eighty miles to the northward, the channel of the river divided at Kakabikansing, forming a sandbar island against the eastern extremity of the slate formation. That sandbar island, almost wholly constituted of river-deposited sand, gravel and pebbles, was then from two to five feet higher than the natural surface of the plain at the eastern side of the glacial river. As the tumultuous floods in that river abated, at or near the closing period of their existence, the first portion of the

bed of the river which appeared above the surface of the water was that sandbar resting against a massive slate formation veined with white quartz. The river then naturally assumed a flowage through the medium of two channels, one east and one west from the exposed sand-bar and slate.

The western channel later prevailed and eroded the present river bed through the decomposing slate formation, reducing the bed of the former eastern channel to a naturally sandy and treeless plain, and sundering the sandbar into fragmental portions now observable near "The Notch" and at the eastern extremity of the mill dam.

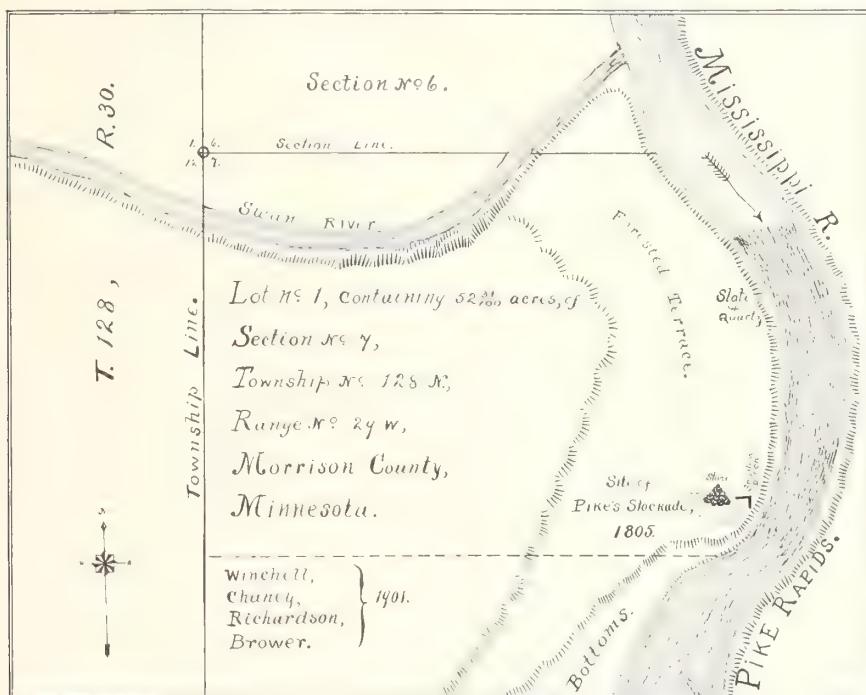
The sand and gravels which formerly constituted that sand-bar island have become the seat of artificially-formed white quartz objects, implements and chippings which extend promiscuously downward into the gravelly and water-deposited mass from a few inches to four feet below the present surface, intermixed with cobbles and pebbles at a higher altitude than any ascertainable position occupied by the quartz veins.

The question to be determined is, in what manner and when did the chipped quartzes become involved in the materials of that sandy and gravelly deposit?

To arrive at a correct conclusion the entire field of inquiry must be traversed.

Mr. Hershey, in his paper which has been quoted at page 46, discusses the question concerning the volume of water which was present at Kakabikansing at its higher stage during the time when the modified drift was being deposited to a complete obscuration of the quartz-veined slate. As the slate rock is now in place above the surface of the water at the crest of the falls and in a decomposing condition which is within about six feet of the altitude of the surface of the highest present elevation of the adjoining sand deposits which formed the Postglacial Island, it is very doubtful indeed if the modified drift was ever present there in sufficient quantity to completely envelop and obscure from sight the entire slate formation. It was undoubtedly submerged at the flood-stage of the glacial river, but as the waters subsided the sand-bar was exposed and the adjoining slate and quartz

veins were immediately in view. Subsequent erosion, the effects of which are now visible, certainly channeled the present stream beds through the slate formation as shown by the east and west channels and the segregation of Mill Island between the two, and it exists there permanently as indisputable evidence that the currents of the river cast asunder the crumbling rocks and gradually assumed their present position. When I first observed the two channels on either side of



SKETCH OF SITE OF PIKE'S STOCKADE, 1805.

Mill Island, in 1861, the principal rapids supplied by the largest. Those known
ERRATA. on of the chart

Read line eleven, page 55, as follows:

which faces page forty-nine of this *Memoir*.

possible, enter
Rapids up the

Mississippi to Little Falls and the mouth of Little Elk River.

Hon. Nathan Richardson conducted my exploration party to the site of Lieut. Z. M. Pike's stockade which was erected in 1805. In the

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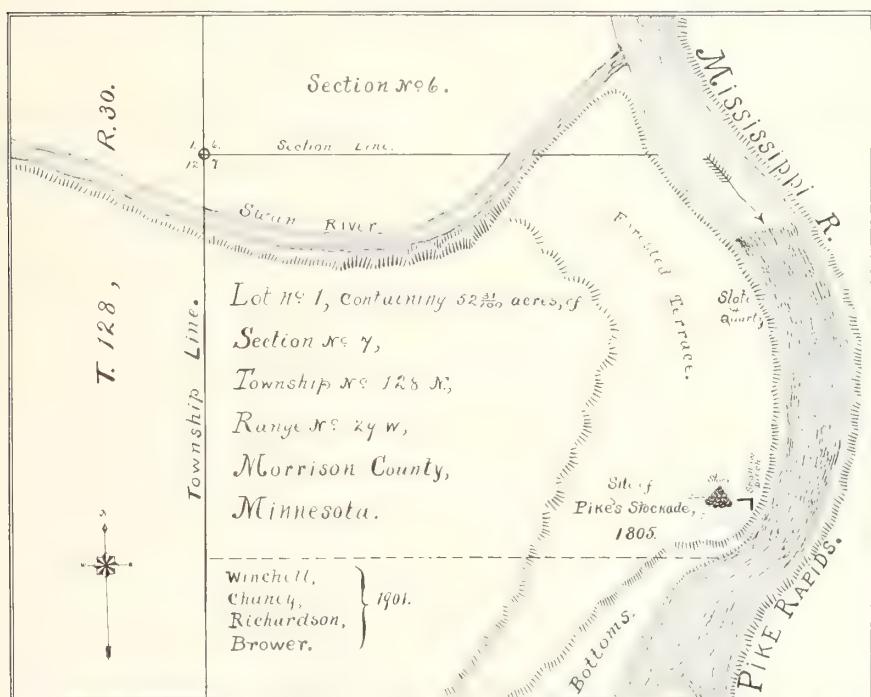
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SKETCH OF SITE OF PIKE'S STOCKADE, 1805.

Mill Island, in 1861, the principal rapids supplied by the largest volume of water flowed tumultuously west of the Island. Those known facts and conditions greatly influenced the preparation of the chart which faces page thirty-three of this *Memoir*.

It is now advisable to carefully, and as briefly as possible, enter upon a consideration of present conditions from Pike Rapids up the Mississippi to Little Falls and the mouth of Little Elk River.

Hon. Nathan Richardson conducted my exploration party to the site of Lieut. Z. M. Pike's stockade which was erected in 1805. In the

KAKABIKANSING — PLATE XVII.



SITE OF LIEUT. PIKE'S STOCKADE.

SITE OF LIEUT. PIKE'S LANDING
October 15, 1805.
West Bank of the Mississippi, at Pike Rapids.



SITE OF LIEUT. PIKE'S LANDING

The pile of stones, which show action of fire, indicates
the site of Pike's fireplace.

company of Professor Winchell and Mr. J. B. Chaney, the locality was explored November 8, 1901. The Mississippi swiftly descends over a formation veined with white quartz. Four distinct surface altitudes were observed; a flood-plain of the river, a terraced formation of modified drift, morainic hills about one-half of a mile to the westward, and an intermediate undulating, sandy plain resting against the south bank of Swan River, as shown by the accompanying sketch. Swan River takes its rise in Big Swan Lake, Todd County, fifteen miles west from Pike Rapids, and it unites with the Mississippi about one-fourth of a mile from

the site of Pike's stockade which was located within a distance of 100 feet from the bank of the river at Lot 1, Sec. 7, Twp. 128, R. 29, Morrison County, Minnesota. The blackened boulders which Lieut. Pike



MOUTH OF SWAN RIVER.

North from site of Pike's Stockade.

utilized in the construction of a fireplace and chimney rest in a pile near a shallow ditch that undoubtedly marks the position occupied by one of the log structures which that officer erected for the use and protection of his detachment. I trust that this brief reference concerning Lieut. Pike's stockade will be accepted as an adequate correction of the error committed at page 126, *The Mississippi River and its Source*, 1893, wherein the site of the stockade was referred to as having been located near the mouth of Two Rivers, about six miles too far down the Mississippi.

The surface of the locality about the site of Pike's stockade is considerably overspread with quartz chippings, which do not seem to enter into the gravel beds that form the river terrace upon which

KAKABIKANSING PLATE XVII



VIEW OF THE FALLS NEAR THE CENTRAL PORTION
OF THE DAM ACROSS THE EAST CHANNEL.



DISCOMPOSING SLATE AND QUARTZ IN THE CHANNEL
OF THE MISSISSIPPI BELOW THE MILL DAM

Pike's stockade was erected. I descended into an excavation which was recently made immediately north from the place where Pike landed, and failed to discover any of the characteristic quartzes more than four inches below the surface of undisturbed materials which enter into the structure of the terrace. This locality was formerly a forest region and little hummocks and hollows so numerously visible all over the pine-covered regions of Northern Minnesota are profusely visible all along the stretch of distance between Pike Rapids and Little Falls on the west or timbered side of the Mississippi. Those hummocks and hollows certainly indicate where a heavy forest has matured, and windstorms or tornadoes have blown down the standing trees, but the hollows are not leveled over and the hummocks, where undisturbed by cultivation, seem to remain numerously intact, occasionally with other trees of recent production growing over them. A cupped boulder and quartz blocks found resting somewhat bedded into the surface of the forested terrace near the site of Pike's stockade indicate the former presence there of a camping party of mound builders. It is best to state here that those ancient people occupied Swan River Valley, constructing mounds at Bear Head near the inlet to Little Swan Lake. Canoe parties passing up and down Swan River seem to have periodically camped where Pike later established his detachment.

Proceeding up the west side of the Mississippi River, overland, from Pike Rapids toward Little Falls the morainic hills, recently formed flood-plains of the river, and sandbar islands, distinctly indicate the development of glacial drift followed by the terracing action of an overflowing glacial river, the chaotic erosion of a natural stream bed, and the more recent formation of river banks and sand-bars. All the peculiarities of a forested region in Minnesota are there present; the flora is characterized by an intermixed coniferous and deciduous production, and it includes perhaps more than one hundred species or botanic varieties, from the white pine, sugar maple and oak, down to the willow and highbush cranberry. Many small marshes intervene, understood to be sustained by an underlying till which absorbs moisture and sustains forestation. Pike Creek flows in from the west as a natural drainage of a portion of the swampy part of



FIG. 1.



FIG. 2.

VIEWS AT LITTLE FALLS, MINNESOTA.

Fig. 1. View showing decomposed slate, and boulders, below mill dam.

Fig. 2. Scene at east end of Little Falls where abutment to dam rests on slate ledge.

that forest region. Along the river banks, at the roadside, in plowed fields, and in the talus near the creeks white quartz chips and spalls are sufficiently plentiful to indicate that man occupied these premises as an ancient game preserve, but quite certainly as procrastinating canoe voyagers, for I failed to observe any particular place fully characteristic of an ancient and permanent village site. At a flood-plain of the Mississippi which exists immediately below the group of modern mills located along an extensive millrace, there is a terrace sparsely covered with timber which is readily recognized as a typical Upper Mississippi River canoe landing. Stone objects of the mound building period have been found there and quartz chips are sufficiently present to indicate that not more than two or three hundred years can have elapsed since the terrace was occasionally occupied by people who portaged around Kakabikansing on their way up and down the river, tarrying meanwhile to obtain quartz and game supplies.

The recovery of potshards between that landing and an upper landing above the falls indicates that the latter must certainly have existed on the west side of the river at the limits of the mound builders' portage notwithstanding the fact that the exact spot is obscured. The locality has recently been subjected to extraordinary modifications by excavations, gradings, railroad tracks and sidings, the establishment of hotels, depots, street grades, warehouses and extensive milling operations, causing it to be an unproductive and somewhat uncertain field for observation. At a vacant block of ground next west from the new Northern Pacific passenger depot three hundred chips and objects were obtained from the surface. To a depth of two feet into the modified drift which formed a portion of the glacial river-bed, the quartz objects also enter into the gravel as a part of its present composition. Proceeding northward I discovered that pine forests had matured along the west side of the Mississippi, many of the trees of which are now growing in clumps, or in scattered order as a result of farming operations or denudation. Small areas of swamps and marshes are intermixed with the forests indicating the lacustrine character of the locality. At the mouth of Little Elk River, two miles north of Little Falls, there is the usual floodplain



FIG. 1.



FIG. 2.

VIEWS AT GRAVEL BEDS, LITTLE FALLS, MINNESOTA

Fig. 1. View at cut through gravel bed on Wood Street.

Fig. 2. Photograph of same cut showing white quartz objects imbedded in the gravel.

of the Mississippi, a higher river terrace, and a more elevated surface to the westward, indicating distinctly the well known recent geologic history of the region from an arctic ice-sheet to the floods of the great glacial river, followed by a channeling of the present streambed of the Mississippi now permanently at a floodstage from the effects of backwater from the extensive milldam below. A few hundred feet up Little Elk River there is an outcropping of slate which has been slightly quarried for economic purposes. I descended into the quarry and removed portions of white quartz from very limited vein deposits, averaging less than one inch in width as now exposed, discovering that decomposed slaty materials enter into the quartz formation sufficiently to deteriorate its quality for chipping purposes. Archæologic indications at this locality are very meager and unreliable.



VIEW AT "THE NOTCH."
(Quartz objects in the foreground.)

With Mr. J. B. Chaney as assistant the continued exploration on the east side was resumed with renewed energy.

Crossing the Mississippi at the mouth of Little Elk River from the west to the east side, the course of descriptive pursuit is now down the river, recording the results of numerous observations as we proceed southward to a prolific field of research at Kakabikansing.

A broad expanse of the Mississippi between the upper railroad bridge at Little Falls and the mouth of Little Elk River, with several channels and islands, is now flooded with backwater, forming an



QUARTZ BLADES IN THE GRAVELLY WALL OF AN EXCAVATED
SANDBANK AT LITTLE FALLS, MINN.

The excavation mentioned was made in 1901, facing Broadway near the east end of the wagon bridge across the Mississippi at Little Falls, at Block B, Mississippi addition, for the purpose of lowering the surface to the level of the street to accommodate the construction of a blacksmith shop. The excavation was three feet in depth, and about 1,000 quartz objects were collected from the sand and gravel which was removed and exposed.

extensive logboom filled with piers, boomsticks, piling and floating pine logs, which obscure from sight most of the natural features of that part of the river. A gradually curving upland border of the river-bottoms recedes toward Hole-in-the-day Bluffs across a flat plain overspread with sandy and gravelly modified drift which forms the prairie upon which the city of Little Falls was originally located as a village about fifty years ago. Along that border on the sandy prairie ancient earthworks of the mound building period were constructed in very limited numbers, constituted, it is said, of one embankment and

a few small mounds which have been obliterated by recent action.

The river banks here curve westward to a narrower channel of the Mississippi over which two bridges have been constructed. A short distance south of those bridges commencing

at the level of the prairie, a wagon road was obliquely cut down through the steep river bank to the flood plain of the river. That wagon road exposed a large number of white quartz blades and objects occurring in water-deposited sand and gravel which overspread an underlying till formation. At the time the sand and gravel beds were being gradually deposited the eastern bank of the river rested against Hole-in-the-day Bluff. The wagon road mentioned, which has been variously occupied and used for about thirty years, was named "The Notch" by Miss Babbitt. She wrote voluminously concerning its



HIGH SANDBANK.
Located 500 feet South of "The Notch."



QUARTZ OBJECTS IN GRAVEL BED ON WOOD STREET,
LITTLE FALLS, MINN.

Wood Street runs north and south along the east side of Block B, Mississippi addition to Little Falls, Minnesota. That street has been excavated from two to four feet to accommodate the construction of a sidewalk on a level with the excavated portion of Broadway which extends east and west along the north side of said block.

The overhanging roots shown in above plate are of wolfberry and wild rose shrubs.

Cobbles were intermixed with the quartz objects exposed.

location, character and peculiarities. Professor Holmes, after trenching, arrived at conclusions entirely contrary to the determinations of Miss Babbitt. A few small trees maintain a stunted and dwarfed growth at and near "The Notch." We sank a pit at the upper defile of the roadway through a limited quantity of alluvium into the sand and gravel bearing quartz chips and objects, and into an underlying bed of pebbles and cobbles. The backwater from the milldam has here permanently submerged the floodplain of the Mississippi and the lower half of "The Notch." The descent from the level plain to the water in the river is at an angle of about 45° . Talus is naturally present, and this permanent bank of the Mississippi at such an angle is to some extent slide material. Half submerged and subjected to long continued use, "The Notch" is now conspicuously not a proper locality at which to apply a supreme and technical test of the true character of the quartzes involved in its gravels. The materials entering into its composition are partly overflowed and much of it has been recently disturbed.

About 500 feet south from "The Notch" there exists an elevated caving sandbank, the crest of which rests at an altitude of about five feet above the plain upon which the city of Little Falls is located. That sandbank must certainly be a fragmental portion of a post-glacial island or sandbar which formed at a time when the Mississippi River flowed in two channels, one past or over the slate ledges, and the other along the base of the western slope of Hole-in-the-day Bluff. It does not contain any considerable number of quartz chips, but as



VIEW AT HOLE-IN-THE-DAY BLUFF.



QUARTZ OBJECTS IN THE WALL OF AN EXCAVATION
AT LITTLE FALLS, MINN.

The quartz objects exposed in one of several pits excavated into the gravelly sandbank at Block B, Mississippi addition to Little Falls, Minnesota, constitute the feature of the accompanying plate.

They were recovered from the water-deposited gravel beds four feet below the surface associated with small, water-worn cobbles intermixed with pebbles and sand.

The quartz objects shown in the plate are not associated with the effects of overturned forests.

it now constitutes a portion of the bank of the Mississippi River at a position where the present current of the stream commences to *swerve to the westward around the location of the slate ledge* at the east end of the milldam, this fragment of a sundered ancient sandbar becomes a factor of the greatest importance in determining the true status of events at Kakabikansing when the Mississippi was a glacial water course, as will be completely demonstrated by the facts ascertained during a continued exploration of the entire locality. Students are respectfully invited to examine carefully the peculiarities of the topography shown on the map facing the title page of this *Memoir* in comparison with Plate XVI facing this section at page 48.

We entered upon an examination of the causes which influenced the ancient channeling of the Mississippi abruptly westward at a bend in the river below "The Notch" and above the falls, which broadened sufficiently to later adjust itself into a doubled channel completely surrounding another more recently formed sandbar island at present submerged. It is a well known principle in hydrography that water seeks exit at the lowest level, and that rock or boulder resistance in the channel sufficient to impede the flowage, increases the water pressure to a stage of erosion which creates rapids. That was exactly the course of natural events at Little Falls. The final lowest channel in the glacial river was formed immediately west from a glacial sandbar resting against the slate formation, and two rapid channels began to form, one east and one west of the present Mill Island. When increased floods and a higher stage of water overtook the locality during regularly recurring seasons of moderate temperature, overflowage would most certainly periodically inundate the entire glacial river bed, forcibly disturbing the surface of sandbars and islands just the same as a high stage of water and floating ice masses in the spring season at the present time change the surfaces of flood-plains in the Mississippi as it now flows occasionally during periodic freshets.

It follows that whatever artificial or other material may have been placed on the surface of the ancient postglacial island at the east end of the slate formation at Kakabikansing, including white



QUARTZ OBJECTS IMBEDDED IN GLACIAL GRAVELS
AT LITTLE FALLS, MINN.

The view is at an excavation into the gravel beds where Block B, Mississippi addition to Little Falls, Minnesota, is located, in the rear of a recently constructed blacksmith shop on Broadway.

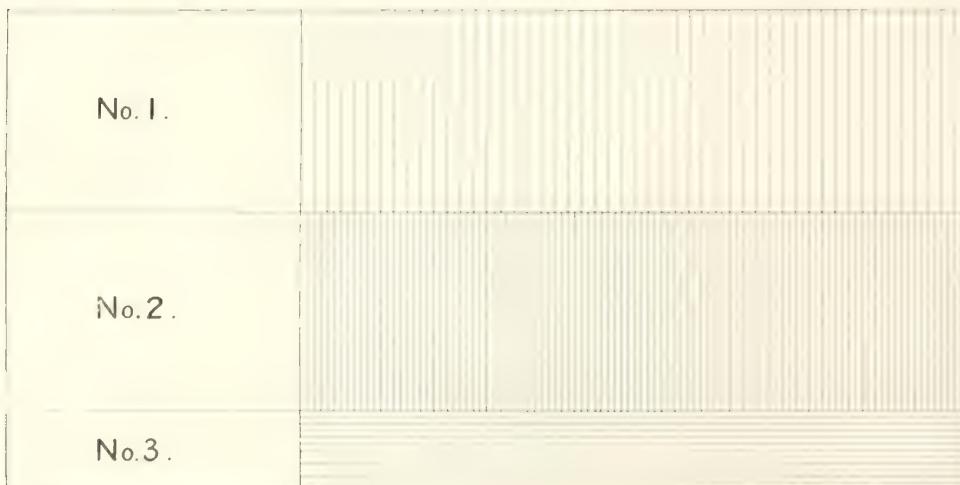
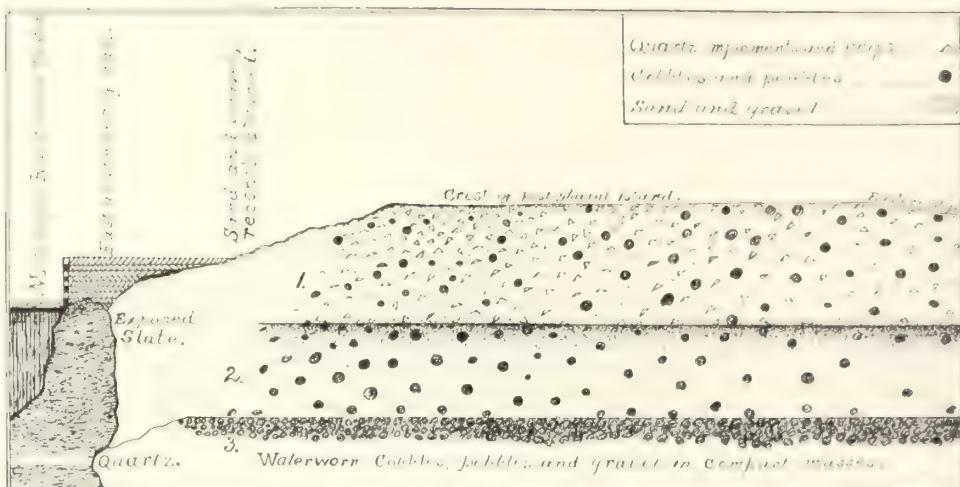
One of the walls of the excavation in which the blacksmith shop was constructed is shown in Plate XXI.

quartz objects, the overflowing freshets, floating ice and newly deposited sand would certainly intermix with the gravel and cover up the quartz objects deposited there during seasons of low-water flowage. As the river receded intermittently from its periodic freshets, again exposing the changed surface of the temporarily inundated sandbar island, whatever people there may have been there, would again advance to the quartz deposits and resume their avocation of chipping blades at the crest of the sandbar adjoining the quarry.

As the river eroded the decomposing slate formation, and formed the rapids, it withdrew to narrower limits, gradually assuming permanent channels at Little Falls as they existed when the present milling operations were established. An underlying till of unascertained depth at and near "The Notch," operated as a permanent protection to the overspread gravel beds which constituted the higher crest of the sandbar formation, and the central intensity of the current of the river was forced by natural causes into a channel which left an elevated point of land resting against the quartz veins in the slate at the east side of the Kakabikansing Rapids. In the material which constitutes the overspread surface of that high point of land, quartz chips and objects are more numerous than any other known postglacial formation at Little Falls. The crest of that formation is level and quite flat, and it is not slide material. Conspicuously it presents the very best field of observation at Little Falls for the characteristic tests which have been applied while ascertaining and determining the identity of the quartz material involved in its composition as it was laid down by the overflowing flood stages of the Mississippi when the ice-sheet of the glacial period was gradually disappearing, and the sandy prairie at Little Falls was flooded by the waters of a tumultuous river, rising or receding according to the vicissitudes of secular aerial temperatures.

I wish to call particular attention to another hydrographic fact of interest at this time.

Whenever the Mississippi in its upper course overflows its channel, a sandy sediment is regularly deposited along the crests of the overflowed banks of the river, causing at numerous localities along its course a series of higher altitudes for the immediate banks of the



DIAGRAMS ILLUSTRATING QUARTZ-BEARING MODIFIED DRIFT
AT LITTLE FALLS, MINNESOTA.

The numbers in each diagram are identical. The upper diagram is slightly exaggerated so as to permit the quartz objects involved in the modified drift to be observed.

No. 1. In each diagram No. 1 represents about four feet of sand intermixed with quartz chips and objects, gravel, pebbles and cobbles. The deposit forms the disturbed crest of a postglacial sandbar island, now part of a flat plain at Block B, Mississippi addition to Little Falls. No trees exist there. Shrubs are scantily present.

No. 2. In each diagram No. 2 represents an underlying mass of water-deposited sand, cobbles, pebbles and gravel.

No. 3. In each diagram No. 3 represents a stratum of waterworn sand, cobbles, pebbles and gravel.

Beneath the sandbar formation there is an underlying till above the quartz-veined slate.

stream than exists at adjoining surface formations and swales. Outward portions of floodplains are often lower than the immediate banks of the river. At Little Falls, Minnesota, the eastern portion of the sandy plain on the east side of the Mississippi is several feet lower than the crest of the plain at the east end of the dam. That fact is important. After the great glacial river which overspread the entire plain at Little Falls had withdrawn into the narrower limits of an eroded streambed, that river, often in freshet from the effects of the melting ice-sheet, occasionally re-overflowed the entire plain, disturbing and overturning the sandy surface, mixing into its materials every chipped quartz blade or spall which had been placed by the hand of man upon the surface adjoining the newly eroded and narrower channel. The higher altitudes of the plain along the Mississippi between "The Notch" and the dam were caused by successive stages of recurring overflowage, creating additional surface deposits upon the plain nearest to the newly formed river bank.

Ages elapsed until new conditions arose. The ice-sheet disappeared, the waters receded into a lower channel which had been rapidly eroded to the bedrock, forming tumultuous rapids; a creek bed was eroded down through the lower plain as a result of natural drainage southward past Hole-in-the-day Bluff; and the city of Little Falls has caused street grades to be adjusted by cutting through the surface of the ancient postglacial island exposing its hidden quartzes, meanwhile filling the lower levels of the street to the eastward.

These determinations are not theories, but ascertained facts obtained by examining the exposed walls of a series of trenches and pits across the plain at Little Falls, calling to my assistance distinguished geologists who have greatly simplified the complicated study by their scientific knowledge. Photographing the walls of excavations, sifting the sands and gravels and gathering therefrom several thousand specimens of white quartz implements, chips, spalls and objects laid down by people who were in contemporaneous existence with the forces of nature which caused the hydrographic action of the floods when the sandy plain upon which the city of Little Falls has been established was surfaced by a water-deposited modified drift, adjusting all

determinations conformable to known hydrographic and geologic peculiarities, and engraving the plates for publication, followed regularly as necessary precautions preliminary to a complete understanding of the interesting features which have developed as this study has established a more certain knowledge of invincible facts which exist as unchangeable conditions at the falls of Kakabikansing.

At the south exposure of the quartz-bearing sandy plain which lies closely against the eastern terminus of Little Falls, in such compact and permanent structure that the eroded channels of the Mississippi were forced around its western extremity, and thence over the slate formation and eastward, bordering portions of the base of that quartz-bearing plain, there is a curved bend in the Mississippi and a lower adjoining floodplain on the south side of the present western extremity of the prairie upon which the village of Little Falls was originally located. That curved bend below the falls was impeded by a diorite formation *in situ* which was undoubtedly one of several natural features which caused the Mississippi to channel its streambed still farther to the westward, isolating "The Point" from the falls.

The locality which has been designated as "The Point" is a high plateau lying immediately above the diorite formation. The floodplain at the "old channel" where one or two springs flow from the base of the declivity, is sparsely forested, the trees being sustained by permanent moisture at a lower altitude than the adjoining plain.

Proceeding southward down the east bank of the Mississippi to Pike Rapids, the sandy plain with an undulating surface was everywhere continuous. Quartz chippings exist in the sand deposits adjoining Pike Rapids where the high bank of the Mississippi overlooks the site of Pike's stockade on the opposite side of the river.

These explorations were considered sufficient, but to assure accuracy in determinations numerous pits were excavated along an east and west line at Little Falls, extending from the vacant block adjoining the new Northern Pacific depot on the west side of the Mississippi, to the eastern side of the plain on the opposite side of the river, penetrating the gravel beds where quartz implements and chips rest in profusion several feet below the surface of the flat prairie. The pits were excavated in

two series, one preliminary and one for a final geologic examination and test, both located across the locality selected as the best for final examination.

Professor Winchell descended into those pits with me, and he has been requested and has consented to contribute for the pages of this *Memoir* the results of his observations, and it is a peculiarly fortunate circumstance that the distinguished scientist who originally discovered the quartz objects described, in 1877, now joins, after the lapse of a quarter of a century, in perpetuating facts heretofore misinterpreted by many writers. A trowel and seive were employed in an examination of the contents of those pits, and the siftings contained in a museum jar reveal a scientific truth which cannot be successfully disputed or disproved, and the sublimity of its importance to American archaeology is far greater than the personal equations and ambitions of all the investigators combined.

ASCERTAINED SEA LEVELS.

Altitudes above the ocean, usually called sea levels by civil engineers, have been ascertained at Little Falls, Minnesota, by the Northern Pacific Railway Company as follows:

	Feet above sea
Old railway depot on east side of Mississippi.....	1120.
At Broadway fill, east side.....	1115.
Surface of ground, near said fill.....	1112.
Upper railroad bridge as first constructed.....	1110.
Bed of Mississippi under said bridge.....	1086.
Surface of same.....	1090.
Present surface at backwater overflow.....	1099.
At junction of L. F. & D. R. R., east side.....	1117.
New N. P. R. R. depot, west side.....	1113.7
New N. P. R. R. steel bridge across Mississippi River.....	1112.7
Foot of rapids below Mill Island.....	1086.

BY MISSISSIPPI RIVER COMMISSION.

Elevation of river surface at base of milldam.....	1091.
Altitude at crest of mill dam.....	1104.
Distance in miles of 5,280 feet from Gulf of Mexico to foot of dam at	
Little Falls.....	2067.

The difference in the altitudes of the railway depots on the east or prairie side of the Mississippi and the west or forested side as shown above is seven feet, distinctly indicating that the east side of the Mississippi at Little Falls is more elevated than is the west side.



§ 3. DIFFERENTIATION.

DISTINCT AND ABSOLUTE IDENTITY OF AGES AND FORMS OF QUARTZ IMPLEMENTS AND OTHER OBJECTS AT AND NEAR LITTLE FALLS, MINNESOTA, SHOWING HISTORIC, SEMI-HISTORIC, NEOLITHIC AND PALEOLITHIC ORIGIN AND ART.

Distinctly, and beyond the possibility of successful dispute, the following several classes of material and objects of human origin are retrogressively applicable to the region at and near Little Falls, Minnesota:

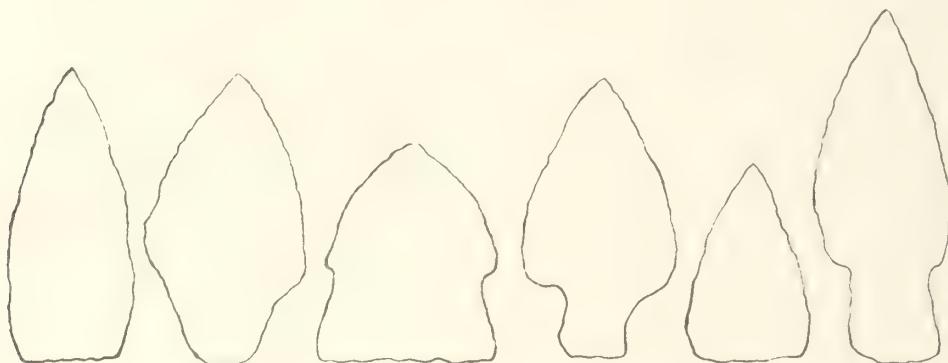
1. Materials of the present white population, with a printed history, and a time basis from 1659 to 1902.
2. Historic Ojibway Indian flintlock shotguns, hunting knives of steel, iron hatchets, hoes, stone pipes, birch bark canoes, and boxed-over graves, with a printed history by Hon. W. W. Warren, a member of the tribe, entitled *History of the Ojibways*, showing a time basis commencing about 1750.
3. Mound builders' artifacts, tumuli, earthern inclosures, fistic objects, copper spears and ornaments, catlinite pipes, earthen hut-rings, and effigy earthworks, identified completely as of ancient Siouan origin by Volumes III and IV of this series of *Memoirs*, entitled *Mille Lac*, and *Kathio*, illustrating the neolithic forms of stone implements and ornaments of the country surrounding Little Falls, where the Dakota bands originated, with a time limit not exceeding 2,000 years.
4. White quartz paleolithic blades and objects involved in a surfaced section of water-deposited modified drift at Little Falls, Minnesota, resting beneath overspread accumulations of the Neolithic and Columbian periods, with a time basis which does not exceed 10,000 years as measured by the channeling of the Mississippi River at Fort Snelling and St. Anthony Falls, where Professor Winchell and

other geologists have on several different occasions computed a time limit for the erosion of the present channel of the river between the two localities mentioned which has taken place since the disappearance of the glacial ice-sheet.

A consideration of each differential class of artifacts as enumerated, is now introduced to indicate the only true and legitimate identification which can be, without prejudice, applied to them.

FIRST: EUROPEAN OCCUPANCY.

The territory about Little Falls was discovered by Radisson and Groseilliers, two Frenchmen, in 1659, when they visited the Dakota



OUTLINE OF NEOLITHIC POINTS OF CHERT AND QUARTZ

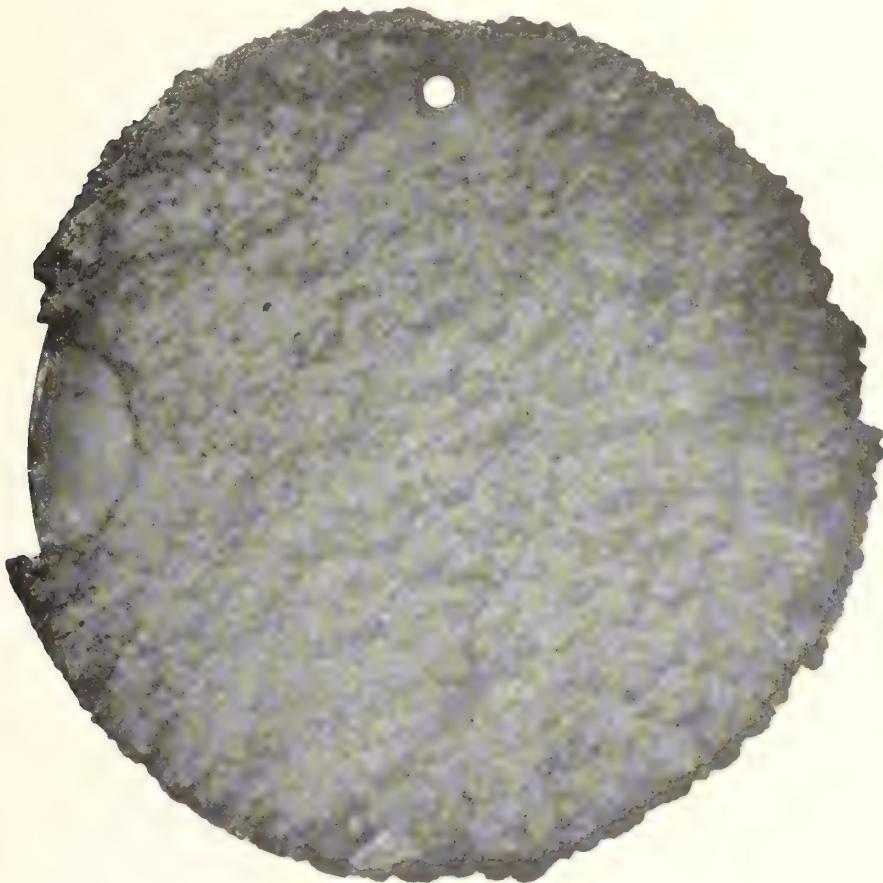
Found at Little Falls, Minnesota.

Indian villages near Mille Lac. Their discovery of the upper course of the Mississippi River is stated in full in Volume VII, Minnesota Historical Collections, entitled *The Mississippi River and its Source*, 1893, pages 47 to 57 and page 294. Those French discoverers were closely followed by Du Luth, 1679; Assault and Hennepin, 1680; Le Sueur about 1690, and the influx of fur traders who established posts at various places in Northern Minnesota during the eighteenth century. Lieut. Pike took possession for the United States in 1805, and Little Falls was established at Kakabikansing soon after the Territory of Minnesota was set apart in 1849. Scattered over the surface of the ground at Little Falls there exists broken glass, pieces of earthenware, fractured dishes, fragments of iron, etc., which permit

the European occupancy to be easily traced by the recovery of numerous specimens of fictile objects, glassware, leaden bullets, implements of steel and abandoned bottles and tin utensils.

SECOND: THE OJIBWAY INDIAN.

The battle of Kathio, about 1750, marks the uncertain date when

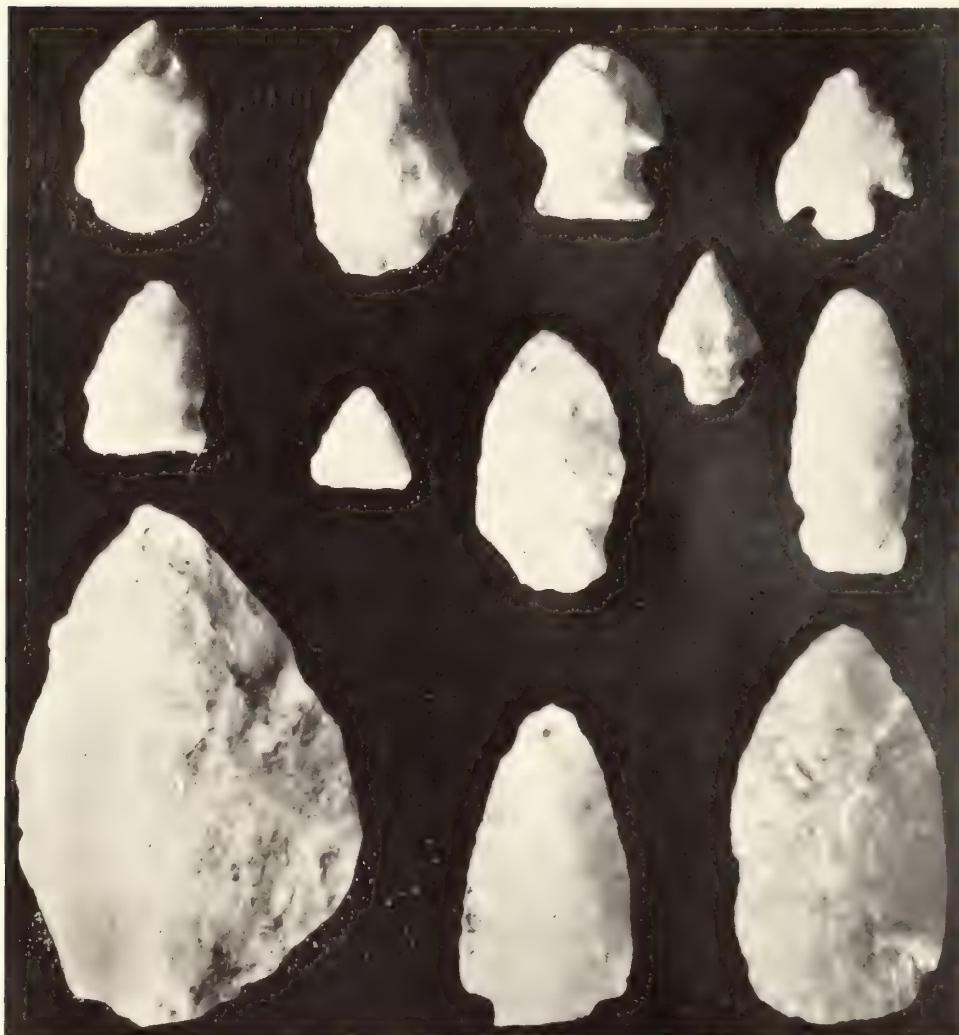


SEMI-HISTORIC COPPER MEDAL.

From outlet of Osakis Lake.

the Dakota bands of Indians were forced to retire southward and surrender possession of Kakabikansing and the Upper Mississippi to the prevailing Ojibway people, who brought with them from Lake Superior and Northern Wisconsin flintlock shotguns, steel knives, iron hatchets and a complete knowledge of the use of powder and firearms.

KAKABI KANSING. PLATE XXVII.



NEOLITHIC BLADES AND POINTS OF WHITE QUARTZ

From Osakis Lake, Minnesota.

They were made from spalls struck off from quartz boulders which are in plentiful supply about Osakis Lake. Mound builders' village sites adjoining extensive mound groups there, yield also copper objects, catlinite pipes, gunflint spearheads and innumerable potshards. Two canoe routes of travel extended from Osakis Lake to Little Falls; one down Sauk River to the Mississippi, and one down Long Prairie River.

Many of the old guns and utensils are now buried in Ojibway graves in Northern Minnesota, where reservations have been occupied by those people until the present time. Since their arrival on Minnesota soil they have not been habitual makers or users of flint implements or weapons.

THIRD: THE MOUND BUILDERS.

When Radisson and Groseilliers proceeded southwest from Lake Superior, in 1659, to the villages of the Dakota Indians near Mille Lac, the Isanti (Santee) band of Siouan stock was at permanent settlements near the great wild rice fields along Rum and Snake rivers. The ancient village sites of those people at Mille Lac and elsewhere, have been systematically explored and identified. Kathio, the principal town, was situated about twenty-five miles eastward from Little Falls, and other large Siouan villages were located at Bromley Lake, near mouth of Pine River, at Hay Lake, along Crow Wing River, at Otter Tail Lake, at Osakis Lake which is due west from Little Falls, and at numerous other localities in the region about the headwater branches of the Mississippi. They are not known as inhabitants of any village at Little Falls, and the true reason why they did not permanently locate themselves there is revealed by the absolutely barren condition of the Mississippi River as a wild rice field. That cereal was their greatest food supply, and their towns were invariably located where the harvesting season would overtake them at convenient villages near the rice beds. Eastward, northward and westward from Little Falls about 5,000 lakes rest at beautiful shores where kettle-holes were formed during the glacial period. They abound with fish and wild rice, and at those lakes the bands of the Seven Council Fires gradually merged into existence from an expansion of an earlier migration from the shores of Lake Superior and central portions of the Wisconsin region, finally forming the Mde Wakanton, Ihankton, Wahpeton, Sisseton, Teton and other bands previous to A. D. 1600, as a nation of fierce warriors before whose aggressive predominance the Iowas, Cheyennes, Minitaris and Crees retired to less dangerous seclusions than they occupied previous to the emergence of

the supremacy of the predominating mound builders, who finally passed into tribal decay from the effects of overconfidence, as shown by the results of the battle of Kathio.

Later, and previous to 1634, the great Ho-he war broke out, involving all of the Siouan bands in the Mille Lac, Little Falls and Otter Tail region, which resulted, previous to Radisson's time, in the precipitate secession and flight of the Assiniboin or Ho-he (rebel) band to the northward.

No specific date can be certainly stated for the first appearance of Dakota Indians upon Minnesota soil. They have been definitely identified as an ancient mound builder race of people. Their village sites, mound groups, inclosures, lodge circles and earthen forts are situated at innumerable localities along the lake shores and tributaries of the Upper Mississippi above and below Little Falls, but they did not maintain a permanent village at Kakabikansing. Their flint arrow points, stone axes, grooved hammers, gunflint spearheads, copper lances, broken clay vessels, catlinite pipes, chert knives, copper crescents, cupped cobbles, fleshing blades, scrapers, awls, gambling stones, beads, cowry shells and various artifacts have been collected from their numerous village sites in large numbers. The mounds contain, in contact with the bones of their dead, exactly the same class and types of artifacts which are found upon their prehistoric and historic village sites. The circumstances which revealed those facts as results of long continued explorations have been sufficiently described in *Mille Lac*, 1900, and *Kathio*, 1901.

While determining those studies vast numbers of glaciated white quartz boulders and cobbles were found throughout the entire region, distinctly of different geologic origin than has been or can be applied to the white quartz in situ at the slate formation at Little Falls. The Siouan bands while occupying their village sites at Mille Lac, Gull Lake, Osakis Lake, and other localities, habitually spalled off flakes and blades from many of those quartz boulders and cobbles, from which they chipped large numbers of stemmed and triangular arrow points, spearheads, blades, knives and disks, leaving innumerable quartz chips, flakes and cores scattered over the surfaces of convenient

grounds which they occupied as permanent habitats. The quartz boulders and cobbles which they fractured for their domestic purposes were almost wholly of better quality and of purer material than the Little Falls quartz. That fact, duly determined by comparison and tests, indicates the true reason why they seldom if ever resorted to Little Falls for supplies of white quartz. They also had chert, diorite and gunflint in large quantities from which were made more durable arrowpoints, knives and spearheads than could then have been made from material obtained from the quartz veins referred to, where constant river flowage has decomposed quantities of the exposed mineral.

During the entire time occupied in explorations at Little Falls, in 1901, not a single arrowpoint, potshard, stone axe, grooved hammer or battered artifact identifiable as of mound builder origin could be



CHERT SPALLS. 1.

From west side of the river at Little Falls.

found. Five chert spalls were found on the west side of the Mississippi which are illustrated on this page. Ten or twelve arrowpoints were found near Little Falls, many years ago, the forms of which are partly outlined on page 78. They are distinctly of mound builder origin, but they do not supply material in sufficient quantity to prove the existence of a village site, or any greater occupancy than should be ascribed to canoe portages around the rapids.

Mr. Richardson, in his *History of Morrison County*, shows also that the earthworks at Little Falls can partly be identified as of historic origin, while the embankment at the crest of the plain was certainly constructed many centuries later than the period when the modified drift was swept into position by glacial floods.

Facts of such a nature, corroborated by convincing and preponderating geologic and archaeologic indications, do not permit the quartz

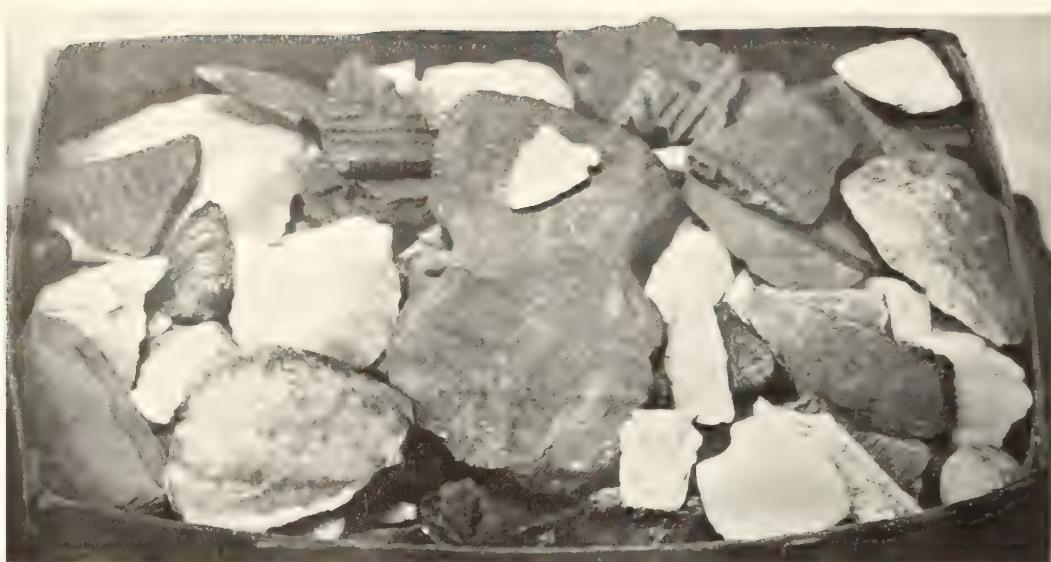


FIG. 1.



FIG. 2.

DIFFERENTIATION ILLUSTRATED.

Fig. 1. Open box containing 500 specimens of arrowpoints, chert and quartz knives, stone hatchets, potshards and chips gathered from mound builder village sites at Osakis Lake, Minnesota. $\frac{1}{4}$.

Fig. 2. Open box containing 1,000 quartz objects and chips from glacial gravels at Little Falls, Minnesota. $\frac{1}{4}$.

In examining the illustrations please use a magnifying glass, which will enhance a knowledge of the remarkable difference shown by a comparison and study of the contents of each box. The Osakis Lake box is filled with neolithic materials, and the Little Falls box contains paleolithic blades and chips.

chippings and blades which have been excavated from, and sifted out of, the glacial gravels at Little Falls, to be erroneously identified as of mound builder origin. They certainly cannot be correctly described as of recent Indian origin.

While the explorations at Little Falls were being carefully considered, a preliminary exploration of the shore line of Osakis Lake was accomplished, and the results of that examination proved that mound builders were permanently located there.

Otto Guy Jeffers, a young student of archaeology who resides on the shore of that lake, has collected large quantities of archaeologic material at various village sites there. A chart of the lake is introduced at page 76 which shows that there is a mound group adjoining each village site. The copper medal illustrated is partly made of rolled plate, and it is incased in native copper battered and hammered over the face of a historic metal structure. The potshards, gunflint spearheads, knives and white quartz points and blades are identically the same types as similar material recovered from the village sites at Mille Lac. Hence the mound builders of Osakis Lake, west of Little Falls, were contemporaneous with the people who established Kathio east from there, and they were of the same nation of people.

The differentiation between the archaeologic material recovered at Osakis Lake, and the quartzes excavated from the gravel beds at Little Falls, is so convincing and undeniable that the contents of a sample box of each type has been engraved, and the reproduction, when closely examined with a glass, will surely indicate to careful and unprejudiced students the impossibility of correctly determining that they are identical. Not one specimen out of 3,500 which were gathered at the sand and gravel beds of Little Falls was grooved, stemmed, battered, ground or prepared for hafting. The box illustrated, indicating the Osakis Lake types, shows all of those neolithic peculiarities. At Kathio, near the outlet of Mille Lac, the archaeologic peculiarities



CATLINITE PIPE.

From outlet of Osakis Lake.
Shows arm and hand holding flint-pointed spear.

and types are the same as those from Osakis Lake. From Itasca Lake down the Mississippi to the mouth of Noka River, the same types also are exclusively present. South of Little Falls for many miles the same differentiation applies, down the Mississippi to and beyond the city of St. Paul.

The mound builders constructed all their tumuli on the surface of the mould and alluvium which covers the drift, and of that material.

It is impossible to determine in good faith that the mound builders were the authors of the chipped quartz blades recovered from the modified drift at Little Falls.

They brought their knowledge of art with them, and it was distinctly of neolithic origin.

FOURTH: GLACIAL MAN.

The certainly known occupants of the banks of the Mississippi River at Little Falls previous to the first advent of the mound builders, were the people whose chipped implements rest in obscurity beneath the gravels and cobbles which form the surface of the plain where that city is now established.

All else is lost in oblivion.

The time which elapsed between the departure of the first human beings who occupied that locality when it was emerging from the effects of a long continued glacial epoch, and the unknown date when the first mound builder appeared upon the horizon of its plain, is a blank to all history. No artifact or evidence of handicraft can be found there indisputably indicating the presence of man between the two dates mentioned. An ancient man appeared and departed, and a mound builder approached and receded. That much we know. All that is left is sifted from the sands, or gathered from the surface and differentiated. The artifacts from beneath the gravels are all of opaque white quartz, which yielded advantageously to artificial pressure. Convex elevations and concave depressions, which distinguish the conchoidal character of the quartz blades at Little Falls, prove that they are of human origin. That proof is augmented and corroborated by forms of discoidal fractures, concavo-convex chippings, and cleavages across the natural

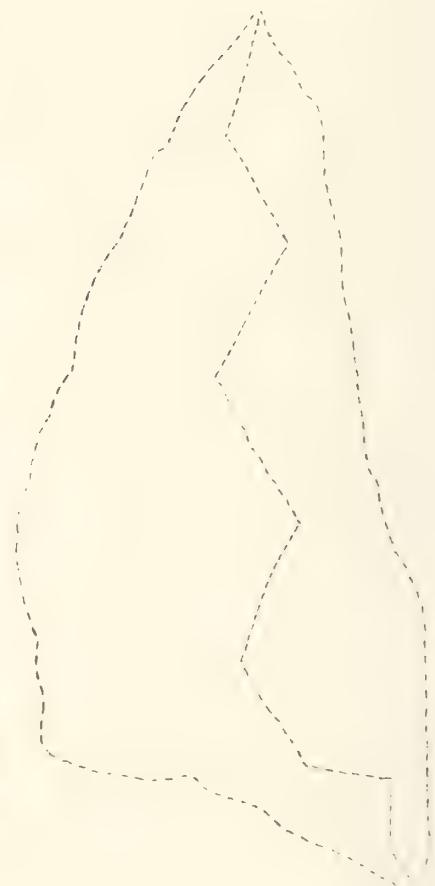
structure of the white mineral. The altitudes of their position, and the segregation of typical specimens at widely different localities up the river from the quarries, constitute distinct additional evidences that the Little Falls quartz blades are certainly of human origin. Not a single potshard, stemmed arrowpoint, spearhead, grooved axe, ground celt, copper knife, shell ornament, cupped cobble or piece of chert or gunflint, or other mound builder artifact, has ever been recovered from the gravel beds at Little Falls where the quartz blades rest beneath water-deposited cobbles and pebbles.

Those facts convince me that fair minded students must look far back of the mound building period for identification of the authors of those quartz blades. That is an unprejudiced statement of facts.

Another unprejudiced student, Professor N. H. Winchell, has been called into this inquiry and exploration, and in person acting jointly we set a date for a final consideration of all the facts. On the 11th day of December, 1901, we descended into excavated pits, gathered quantities of material for our final study, and proceeded deliberately to a repetition of former similar considerations and examinations with the sifted gravels and quartz artifacts spread out on convenient receptacles, as shown in the engraved museum jars in this *Memoir*. A conclusion was then reached that man was present in the Basin of the Mississippi before the ice-sheet of the last glacial epoch had disappeared from the northern part of Minnesota.

That people brought a rude art with them, and it was strictly of paleolithic knowledge. There are no evidences at Little Falls that they used the bow and arrow, and no quartz implement made by them was prepared for hafting at that time.

They had no knowledge whatsoever of the existence of catlinite, or of the extensive deposits of gunflint on the northern border of Minnesota, a fact which is shown by a conspicuous absence of those materials from every known locality which they occupied. Clay vessels were unknown to them, and their art was the most primitive known to the Western Hemisphere and probably the earliest in North America.



CHIPPED BLADE OF GREENSTONE.

The above illustration is a reproduction of the only chipped implement other than white quartz which was found at Little Falls during the season of 1901.

It was recovered from the surface on the west side of the Mississippi and it was probably used as a rude fleshing blade.

§ 4. THE GEOLOGY OF THE MISSISSIPPI VALLEY AT LITTLE FALLS, MINNESOTA.

BY

N. H. WINCHELL.

Having participated with Mr. J. V. Brower in a recent review of the evidence of early man at Little Falls, at his solicitation, and having been requested by him to prepare for publication a sketch of the geology of the region, the writer, in the preparation of this sketch, wishes at the outset to acknowledge the assistance of all previous investigators who have published accounts of the region relating to the origin and date of the human artifacts found there in the gravel, and which have been quoted by Mr. Brower in the first section of this *Memoir*.

The special petrographic geology of the rocks at Little Falls is given by Messrs. Streng and Kloos in a paper published in Germany, but translated by the writer and republished in the eleventh report of the Minnesota Geological Survey (pp. 30-85), 1882. Further petrographic descriptions are given in Volume V of the third report of the Minnesota Survey, pp. 568, 756, 757 and 758.

THE ARCHEAN.

The rock formations seen at Little Falls and at Pike Rapids belong in the Archean, and probably to the Upper Keewatin. The Archean is divided into two principal members, on a stratigraphic basis, viz: the Lower Keewatin and the Upper Keewatin. The Lower Keewatin is found in the low, dull, greenstone knob seen at Randall, near the station. It probably underlies a considerable tract in western Morrison County, but the drift is so abundant that its geographic area cannot be given. The rock at Randall is a part of the oldest

known formation, and probably formed a part of the original crust of the earth.

Later than this the Upper Keewatin was formed as a sedimentary formation, and this is found at Little Falls and at Pike Rapids. It consists, in the main, of fine-grained mica schist which is garnetiferous and staurolitic and carries numerous veins of white quartz. The Upper Keewatin in some places at Little Falls is quite slaty, approaching roofing slate, the slatiness standing nearly vertical, striking N. 18° E.; and in others it is of nearly the same composition and color but is not perceptibly slaty. It is, however, uniformly jointed, and this jointing, when viewed at a distance, gives the rock the appearance of being conspicuously stratified, with a dip up the river about 45° from the horizon. There are two other systems of joints which intersect each other at a small angle, cutting the slates into rhomboidal masses as they disintegrate under the action of the weather. The chief exposure, prior to the erection of the mills and the building of the dam, was an irregular expanse in the river channel and more or less along the banks and bottom land. There was an island in the river, and a dyke ten feet wide of dark trap visible on the west shore, rising a few feet in the west bank. In the lee of this dyke was a mass of greenish, soft, decayed rock, probably largely from the dyke itself, protected from the current and floating ice by the body of the dyke. This dyke may be of the age of the gabbro mentioned later, as these rocks are allied in composition and origin, both being intrusive.

The Upper Keewatin varies also to a rock which approaches dioryte in composition. These variations are curiously distributed. They compose lenticular crystalline masses that are always vertical and coincide in their longer diameter with the slaty cleavage, crossing the sedimentation. Their existence is not dependent upon the direction, but apparently on the character of the sedimentation under the action of some later force. The same is true of the white quartz veins, as they also run with the cleavage. These dioryte septaria frequent certain layers of the sedimentation, occurring in a belt parallel with the sedimentary structure, at least in one place on the island where carefully examined, though individually even then they are elongated

with the cleavage. This varying nature of the original sediments in the midst of the slates is in harmony with and indicates the existence of sources of supply of sedimentary material which differed much in kind while the Upper Keewatin rocks were being accumulated in the bottom of the ocean.

The same kind of variation is more conspicuously exhibited on "The Point," i. e. what was formerly known as "Campbell's Point," which juts into the river from the east bank not far below the dam. Here the rock is gneissic, and in some parts is banded by parallel alterations of very siliceous and very basic ingredients, these bands exactly simulating a sedimentary structure. The rock, however, is not an ordinary gneiss, since the darker bands are composed of those basic minerals (hornblende, augite, plagioclase, titaniferous magnetite), as an indication of original, basaltic, igneous agency, while the lighter bands contain the acid minerals (quartz, mica, orthoclase, oligoclase, etc.), which are evidence of metamorphic acid sediments. We have to infer therefore that in Upper Keewatin time, while ordinary detrital forces served to gather the usual elements of a sedimentary rock, there were sources ready in the neighborhood to supply the elements that come from basic igneous activity. Such elements may have been in the form of volcanic ash in whole or in part, but may also have been the product of friction by waves upon some preexisting basic rock in the immediate neighborhood. That, furthermore, is in perfect harmony with what is known of the nature of the Keewatin, both upper and lower, in the northern part of the state and widely in Ontario and Keewatin.

There is no known granite in the immediate vicinity of Little Falls. It occurs in Morrison County toward the east and in Stearns County toward the south. It is not known by observation that this granite, which is a part of that formation which has borne the name Laurentian for many years, is older or younger than the Little Falls slates; but by analogy we suppose the slates, and especially the green-stone seen at Randall, are older than the granites of Morrison County, the granites being intrusive, at least into the slates.

In the western suburbs of Little Falls is a quarry in gabbro.

This rock is very similar, petrographically, to the rock which forms the hills back of Duluth, and there is some reason to assume that it has the same age. In that case it is younger than all the other rocks mentioned, and it has penetrated the slates and other rocks of the region in the form of an enormous dyke. Its positive relations to other rocks, however, are wholly unknown. The exposure is not sufficient to reveal its contact on any other rocks.

After the formation of the foregoing rocks the area in the immediate vicinity of Little Falls was probably not disturbed by submergence beneath the ocean, nor upheaved and broken by internal forces so as to cause the escape of molten rock from the interior of the earth for a very long period of time—indeed the most of the time included within recognized geological history. This can be inferred from the total absence of later formed rocks. But such an inference is not safe, since stupendous forces of erosion, such as the ice of one or of several glacial epochs have passed over Morrison County and may have carried away a thousand feet or more of rocks that formerly may have existed at Little Falls. The Paleozoic sandstones of Sherburne and Pine counties may have been extended at first over Little Falls. Enormous thickness of soft red shales and sandstones, and of alternating trap sheets, may have covered Morrison County. Even the Trenton limestone which forms the brink of the falls of St. Anthony may have extended so far north as Little Falls. These are all near the bottom of the Paleozoic, and if we allow the possibility of their former extension to Little Falls, it is as far as we can go. We cannot admit the Upper Silurian nor the Devonian. As for the Carboniferous age, that of the coal measures of Illinois and Iowa, it probably passed while Little Falls was dry land. The Permian and the Jurassic passed in the same way. The ocean toward the south had complete sway over the most of the area of the United States while the nucleus of the continent stretched across Minnesota and supported the grotesque saurians and ornithosaurians characteristic of those ages, whose remains must have been once abundant in Morrison County, but which have been lost by decay and glacial transportation.

It was not till the opening of the Cretaceous, the last step in

Mesozoic time, that Morrison County began to feel the internal throes of approaching catastrophe. For some reason the state of Minnesota was submerged under the ocean. The old rocks had become decayed to the depth of a hundred feet or more. The ocean soon loosened this soft material and distributed it in its own way. That is why the basal strata of the Cretaceous everywhere in Minnesota are prevailingly kaolinic. Some remains of the Cretaceous still exist in Morrison County, and some characteristic fossils have been found therein, viz., at Two Rivers. Since there is evidence that the submergence extended much farther north and east, it is very evident that the site of Little Falls was covered by a wide oceanic expanse. Subsequent glacial erosion, however, has mostly destroyed the Cretaceous strata that resulted from this submergence.

Then the ocean retired, and another age of quiet passed. During this age (the Tertiary), Morrison County and the state of Minnesota were the habitation of huge bizarre mammals. These monsters, which are now extinct, ranged over the continental areas from the Atlantic to the Pacific, but the Pacific shore was then much further east than it is now. Indeed nearly one-half of the area of the United States has been added to the land surface since the close of the Cretaceous, and much of it since the opening of the Tertiary. The length of time involved in the reign of the great mammals cannot be estimated in years. It is only possible to mention some of the geologic events that took place during the Tertiary, and, by noting the vastness of the operations, to gather some conception of the time necessary.

1. These animal types were evolved from preexisting types from which they differed.
2. They flourished and expired.
3. Mountain ranges were raised.
4. Since the formation of the mountain ranges (many of them in the Eocene, or at its close), these mountain ranges have suffered enormous erosion by streams. Gorges and canyons hundreds of feet deep and hundreds of miles in length have been excavated by the rivers, sometimes in the sedimentary rocks and sometimes in the granites.

If these changes be compared with the time involved in the erosion of the Mississippi canyon from Fort Snelling to Minneapolis, which has

been found to be between 7,000 and 10,000 years, the Tertiary age seems necessarily to have been 100,000 or 200,000 years in duration. We do not know whether primitive man witnessed any of these events. We do not know that he did not.

THE GLACIAL EPOCH.

We come now to consider the phenomena of the Glacial Epoch—that which is of more interest than any other part of the geology of Little Falls, since in the surface gravels at Little Falls are found human implements—or at least the chippings that are accepted by archaeologists as proof of the agency of man in the construction of his implements.

So far as the facts at Little Falls are concerned there are but three main parts that make up the drift deposits. It is not necessary to inquire as to the existence of other facts in other parts of the state, nor to note the minute sub-divisions of these parts, which are as follows, in descending order:

1. Disturbed gravel and sand of glacial origin.
2. Undisturbed gravel and sand of glacial origin.
3. Till, red, and mainly derived from the northeast, lying on the Archean slates.

These main parts were deposited in reverse order of time. The till (No. 3) is the direct unmodified product of glacial action. The stratified gravel and sand (No. 2) is the immediate product of waters laden with the detritus from the till. The water was abundant and tumultuous and resulted from the dissolution of the glacier which must have been present in the immediate vicinity. The presence of the glacier is proven by the fact of the copious supply of material which it alone could have brought within reach of the waters. The waters themselves might have been supplied, and were supplied, in perhaps equal volume when the ice margin had withdrawn many miles further north; but they were then reduced to the condition of a steady river, a mighty river it is true, and yet unable to carry along and obliquely stratify gravel and sand so coarse as that seen in No. 2. In No. 2 the stratification is typically such as is known by every geologist and

unhesitatingly ascribed to glacial waters acting on and washing the till brought forward at the ice margin. It is prevailingly nearly horizontal at Little Falls, but in some cases it is plainly oblique. It is both coarse and fine. Some layers, several inches thick, consist largely of cobble stones from one to four inches in diameter, and some of gravel whose grains are about one-quarter or one-half inch in diameter. The major part of it, however, consists of sand whose grains are as large as mustard seeds. It is all fresh and clean, presenting that freedom from rust and organic action which all fresh gravels exhibit.

No. 1, however, inasmuch as it contains the quartz chippings, required careful examination before its origin and history became evident. It was necessary to make two, special, recent trips to Little Falls, directed specifically to an examination of this surface deposit before the conclusions given below could be acceptably formulated. The point that was specially critical of determination was this: Is No. 1 a modified condition of No. 2, or is it of later date? In other words, is it of glacial-water origin, or is it of later alluvio-lacustrine origin and date? Was it originally the upper part of No. 2, or was it accumulated later by the agency of the river or by wind?

It is a well known fact that along nearly all rivers there is a lower bottom land, or floodplain, which is annually movable by the high waters of spring, and that it presents different composition and pose after every such flood. It had to be determined whether these surface materials, which have been denominated often "loam," could be assigned to the floodplain stage of the Mississippi at Little Falls.

Now it so happens that at Little Falls one of the principal chip-bearing localities is on one of the most elevated positions of the gravel flat on which the city is built. It is near the river, at the east end of the main bridge. It is, indeed, the same place as that where the writer made discovery of these chippings in 1877 and noted that they occur about three feet below the natural surface. The present river never covers this flat. It is 27 feet above the level of the river prior to the construction of the dam. The river has at present a lower floodplain. If any river ever covered it, it must have been the

great river that was born of the tumultuous waters issuing from the dissolving glacier, and hence it must have dated far back in the history of the river. But here arose the query whether a simple river, even a great river, with the average descent of the Mississippi at Little Falls, could transport cobblestones two or three inches in diameter; and hence, if it could not, was it not likely that this surface material (No. 1) was deposited at the same time as the stratified material that composes No. 2? At this point it was determined to visit Little Falls again, with view to discovering whether No. 1 is the upward (original) extension of No. 2. Mr. Brower had seven fresh pits dug for this special re-examination, penetrating through No. 1 and passing from two to four feet into No. 2. On visiting these pits the following notes were recorded:

Pit No. 1. On the west side of the river, near the Northern Pacific depot, above the dam, on the general flat, on Broadway.

1. Soil, 4 inches.
2. Mixed gravel and sand, all disturbed, but containing gravel half an inch in diameter. 4 feet.
3. Coarse gravel and sand, with pebbles and cobbles two to three inches and even four inches in diameter. 6 inches.
4. Coarse gravel, etc., not penetrated except by spade. At least one foot.

In pit No. 1 curious modifications are seen in the disturbed material. Cleaner and lighter colored bodies, or lenses, or cylindrical masses of sand occur in the darker sand, these lighter colored parts being slightly gravelled. These are round and oblong and lie sometimes perpendicular and sometimes horizontal, varying from two to six inches in diameter. Can they be due to ancient roots rotted *in situ* or pulled out, subsequently filled by washed sand from above? This is on the originally timbered area, trees growing all about.

Pit No. 2. On Broadway near the bridge, on the east side of the river, on a southern slope about six feet below the general flat where numerous chips have been found.

1. Sandy soil, two to six inches.
2. More sandy, mixed, with some cobbles four inches in diameter, and many pebbles. 3 feet.

3. Coarser than No. 2, disturbed. 3 feet.
4. Belt of cobbles two to three inches in diameter, not disturbed. 4 inches.
5. Sand, not disturbed, light colored. 6 inches.
6. Cobbles and sand, some of the former six inches in diameter.

This pit is near the largest deposit of quartzes and two hundred feet east of the quartz vein, and south from the blacksmith shop. The materials show no sign of wind action. The contained pebbles are too coarse.

Pit No. 3. One hundred feet northeast from pit No. 2. Edge of the general flat, near the blacksmith shop, perhaps six feet higher than No. 2.

This pit shows substantially the same section as No. 2, except that it does not go so low, and the upper portion still contains gravel too coarse for the wind to carry. It shows but rare cobbles. Chips of white quartz occur in the upper three feet of this pit.

Pit No. 4. Half a block south from Broadway, on Wood Street, and half a block east from pit No. 3.

1. Disturbed glacial gravel and sand in which quartz chips are common, also some cobbles three and four inches in diameter. The general composition of that part containing quartz chips is sandy, with numerous rootlets of wolfberry, sumac and wild rose. The wolfberry rootlets are half an inch in diameter, and some are four feet below the surface. 4 feet.
2. Cleaner glacial sand, becoming coarser, with cobbles, undisturbed. 4 feet.
3. Nearly all cobbles, not penetrated, at least one foot.

No wind action is discoverable here. Stones are to be seen at two inches below the natural surface. This pit begins on the general flat, same level as No. 3. This is by the side of a north-and-south street. In the upper material, in which quartz chips are found, are some rounded cobbles of granite, etc., reaching four inches in diameter. Nothing is yet seen in these pits to indicate a different date or origin for the disturbed gravel and sand, but it appears to have been originally the modified gravelly drift, as the glacial waters left it, and that by some means it has lost its stratified structure.

Pit No. 5. Is nearly opposite pit No. 4, on the same street, and

about one hundred feet distant. It shows the same. The whole section consists of material that is of glacial origin, fine toward the top, with quartz chips.

These pits are all from four to eight feet deep and reach to undisturbed glacial gravel and sand. One can but be impressed with the fact of the glacial nature of all the material shown by these pits, although they have a more fine and sandy nature near and at the surface.

Pit No. 6. Four hundred and fifty feet west of the Buckman hotel, diagonally across from the City hotel, six hundred and fifty feet east of the river.

1. Stratification lost, but contained originally some cobbles three and four inches in diameter, with rare quartz chips, rather sandy loam. $3\frac{1}{2}$ feet.
2. Cobbles and pebbles, disturbed. 1 foot.
3. Fine sand in distinct stratification, strata sloping south about three or four degrees. 4 feet.

Here are no signs of wind action, nor of alluvial deposition since the withdrawal of the ice. This pit begins at the general level, but near the commencement of a descent to a lower flat or terrace.

Pit No. 7. Is near the Northern Pacific railroad, perhaps a quarter of a mile from the river, on the east side, in the edge of a little gully. It is shallow, perhaps two feet deep. Here are seen no quartzes, the materials are coarse gravel and sand, almost from the surface.

CONCLUSIONS BASED ON THE PITS.

These pits all tend to show the following:

1. The glacial gravels extend upward to the present surface, but sometimes they vary both near the surface and at considerable depths, to coarse sand.
2. They are so coarse that, as a whole, they could not be disturbed by wind, though local dunes might be formed on them.
3. They are so coarse that, as a whole, they could not be disturbed, at least they could not be transported, by a gently flowing stream such as the Mississippi river at this place, although locally alluvium might

cover them. The prevailing greater fineness of the upper portion of these sands and gravels is to be attributed to the waning supply of materials at any certain point as the ice-margin retreated further toward the north.

4. There are some cobblestones well up toward the surface of the ground, and these must have been brought into the materials at the same time that the finer parts were accumulated.

5. The original stratified structure is by some agent obliterated in the uppermost three to five feet, but generally not deeper than four feet.

6. The line of separation between the disturbed and the undisturbed gravel is sometimes quite distinct and the change is abrupt, but usually the transition is gradual; the remains of some of the coarser strata continuing further up into the more disturbed portion.

7. Were it not for the coarseness of some of the ingredients in the disturbed portion and the occasional evident continuance of the strata below into the disturbed part, it might be thought that the upper portion was derived subsequent to the stratified portion by some alluvial action, and that hence these parts are of different dates. I paid particular attention to this possibility, but was obliged to abandon it, and to accept the unity of date and identity of origin for these two parts.

8. The quartz chippings are only in the upper, disturbed part of these glacial gravels.

9. It remains therefore to explain the superficial disturbance and the introduction of the quartzes.

10. So far as observed this disturbed condition of the upper part of these gravels is widespread—indeed, is universal. Hence the cause must have been one that operated throughout the valley, i. e. from the eastern drift bluffs to the western, a distance of about two or two and a half miles, that being the width of the river when the gravels were deposited.

11. It cannot have been caused by currents of the river, because that would have formed a secondary stratification, and would have

brought only the finest sand on to the surface. This is seen occasionally, and such secondary deposits are apt to be loamy.

12. It was not due to wind, as already stated.

13. It was some agent that acted in the valley and seems to have had some relation to the river itself.

14. Trees turned over by wind may produce locally such phenomena, but that cause was not effective here, because:

(a). There is no forest now on this surface on the east side of the river where the pits were excavated.

(b). There is no sign of a forest such as required by this hypothesis, at any earlier date, on the east side of the river, and the differing tree-bearing quality of the soil of the east and west sides of the river now subsisting must have existed from the time of the deposition of these gravels. A few scattering stunted oaks subsist in the sandy soil of the east side, but on the west side formerly grew a heavy forest of elm, white pine, bass, maple, birch, boxelder, etc., typical of strong, moist soils of that part of the state.

(c). On the west side of the river such a cause may have operated, since the characteristic oval or elongated low mounds formed by the upturning of the soil by overblown trees are there quite common. Such mounds when turfed over are very lasting, being sometimes a foot, or even two feet high.

(d). The most abundant locality for the quartzes is on the east side of the river, on a portion of the sandy plain slightly elevated above the most of the Little Falls flat, where there is no trace of such ancient forest and where the manner of disturbance of the gravels cannot be ascribed to tree roots.

(e). The wide, uniform distribution of this disturbed condition is not like that which would result from the overthrow of trees.

15. The disturbance resulting from trees and all other vegetation, and from animals, must have contributed to this condition of the surface of this plain but a minor part of the features here under consideration.

16. Floating and jamming ice in spring when the ice of winter breaks up is a powerful agent. This must have been more powerful

when the river filled the valley from bluff to bluff. The water must have been shallow, and the winters severe enough to form ice two or three feet thick.

17. On breaking up annually for perhaps several thousand years, many shifting in the active channel must have taken place, and many ice jams must have plowed into the loose materials below the water. Such action would disturb the preexisting structure of the gravels, but could not far transport any of the materials.

18. These jams, and all floating ice, must have impinged first on the sandbars and shallow places in the river.

19. This high stage of the river prevailed after the retirement of the ice-margin of the last continental glacier from the vicinity of Little Falls, and till it passed so far north that the discharged waters did not gather into the Mississippi river, but went by some other route to the ocean.

20. That interval of time may have been one or two thousand years.

21. When it closed the Mississippi shrank to about its present dimensions, beginning the excavation of its present narrow gorge. The recession of the Falls of St. Anthony from Fort Snelling has been subsequent to that shrinkage.

22. In order that jamming ice could tear up the gravel and effectually destroy its stratification, and could bury these quartzes to the depth of three or four feet, those quartzes must have been present at the time of disturbance.

23. Hence the aborigines that formed the quartz chips were at Little Falls during the floodstage of the Mississippi mentioned in No. 19. They seem to have found the quartz veins, and probably some of the slates projecting above the river level, and in the summer time they seem to have done the chipping on the plain adjacent, which was uncovered by the seasonal retirement of the river. They must have followed up the ice-margin from the south.

24. There are hence four steps or epochs in the glacial geology of Little Falls, which can be distinguished from each other, and which may be defined succinctly as below:

(1). *The glacial epoch proper*, when ice covered the country to a great thickness and extended indefinitely southward.

(2). *The gravel accumulating epoch*, when the ice-margin was at or but little above Little Falls. It was so near, and the slope of the ice was so precipitous that the materials supplied by the glacier were immediately washed by the glacial waters, the clays being carried away, while the gravels were spread in stratified assortment over the till sheet which still underlies them. This ice-margin continued to retreat northward, forming a sheet of stratified gravel and sand all the way, but

(3). At Little Falls during this retreat was the *extended river and ice-jamming period*, marked by the disturbance of the upper part of the gravels and by the introduction of the quartzes.

(4). The shrinkage of the river to its present size and the *cutting of the narrow present channel*. This epoch may have lasted 10,000 years and continues to the present.

The opinion of Miss Babbitt that these chippings are of glacial age was based on faulty observation. She explored the east bank of the river at "The Notch" where she reported the finding of a continuous layer of quartz chippings underlying the major part of the glacial gravels. She also failed to notice that they occur on the surface generally at that place. Her errors have been pointed out fully by Prof. W. H. Holmes,* and her conclusions shown to be invalid.

Mr. Warren Upham accepted in the main the work of Miss Babbitt and reached the conclusion that the man who chipped the quartz lived at Little Falls during the accumulation of the undisturbed gravels, i. e. that the ice was still present in the immediate vicinity.† He made no distinction between the disturbed and the undisturbed portions of these gravels. It is now known that the chips do not occur in the undisturbed gravels.

Profs. Putnam and Haynes also followed the descriptions and conclusions of Miss Babbitt, supported as they were by Mr. Upham.

Prof. W. H. Holmes made a thorough examination of the locality, and published his conclusions in April, 1893.‡ The writer accompanied Prof. Holmes and concurred in his findings that the quartzes described

**American Geologist*, Vol. XI, pp. 218-240, April, 1893.

†*American Geologist*, Vol. XIII, p. 363, 1894.

‡*American Geologist*, Vol. XI, pp. 218-240, 1893.

at "The Notch" by Miss Babbitt were not in, nor below any normal glacial deposits, and that they are, on the other hand, found only in surface materials of the general flat on which the city is built. Mr. Holmes reached the conclusion that all the chippings are quite late, certainly postglacial, and probably due to the existing Indian tribes. This result may have been reached in part by reason of the existence of quartz chippings immediately associated with other implements in the very surface materials, even in the soil, in groups and pockets, such as can be attributed readily to the present Indian. These are found on the west side of the river, and on the lower terraces all the way to Pike Rapids, and probably extend widely.

Mr. O. H. Hershey first differentiated these modern chippings from those found in the disturbed glacial gravels,* and assigned a probable later date to the former. This distinction seems to be important and tends to weaken any conclusion that ascribes all the chippings to one and the same date and origin; and it tends to separate under different causes a lot of facts that have been looked on as attributable to a single cause.

The result reached by the present investigation differs from all the foregoing. It recognizes a period of 1,000 or 2,000 years during which the Mississippi flowed as a majestic river past the site of Little Falls, submerging all the plain from two to two and a half miles wide between the outer drift bluffs. This was wholly subsequent to the accumulation of the glacial gravels. It was during this period that these chips were formed, and were introduced, probably by floating and jamming ice and floodwood, into the uppermost three or four feet of those gravels. The quartz and slates must have formed a small projecting knob above the surface of the water, and probably there was annually considerable dry land in the immediate vicinity on which the quartz chippers did their primeval work. Since that time this projecting knob of quartz and slate has been greatly reduced, but it has always formed an interesting obstruction in the current of the river. The overthrow of trees by tornadoes and the action of burrowing animals may have contributed later to the disturbance of these

**American Geologist*, Vol. XXIV, pp. 283-294, 1899.

gravels, but they seem to be insufficient to produce the grand effect. The quartzes must have preceded the disturbance, and the only adequate cause of the disturbance is one that acted, as it appears, while the river was swollen by glacial waters coming from far north. That makes the chippers postglacial, but much earlier than the present Indian.

MINNEAPOLIS, December 22, 1901.

EDITORIAL NOTE. At the last conference held with Professor Winchell, January 23, 1902, I stated to him that the surface of the plain at Little Falls, Minnesota, had been solidly frozen and rapidly thawed out more than 9,000 times; a sufficient cause to slightly disturb the stratification of the glacial sands and gravels there, to a depth of more than four feet. He accepted that fact as all important, and as a perfect proof of why and how the modified drift was slightly disturbed, as a universal occurrence.

The fact stated will apply to Trenton, New Jersey, as well as to Little Falls, Minnesota.



ARROWPOINTS OF THE NEOLITHIC PERIOD. 1

From Kathio, near Little Falls, Minn.



§ 5. CONCLUSIONS BASED ON ASCERTAINED FACTS AND ACQUIRED KNOWLEDGE.

BY

J. V. BROWER.

Having personally explored the region of country at and about Little Falls, Minnesota, and all its geological and archæological peculiarities so far as necessary, and calling to repeated conferences the distinguished geologist, Professor N. H. Winchell, the last of which was engaged in on the 23rd day of January, 1902, and while contemplating the necessity of reducing possible error to the very lowest minimum, there are found to certainly exist a series of facts heretofore misunderstood, unexplained, or unknown, which are of the greatest importance to the archæological history of the Basin of the Mississippi, no less than the actual occurrence of paleolithic unwaterworn quartz blades, of human origin with no definitely ascertained history, which rest beneath cobbles, pebbles, gravels and sand found occupying the exact positions where they were deposited at the closing period of the last glacial floods which overspread the entire plain upon which the city of Little Falls is now located.

There is no personal purpose to enhance, no prejudice to assuage, and no favors to grant by this inquiry; a cold, unconcerned, deliberate determination of actual facts for and on behalf of the Minnesota Historical Society constituting the only obligation.

An invitation was extended to representatives of contending factions in American archæology to be present at Little Falls at a stated period in November, 1901, to participate in one of several examinations which have been engaged in there. That mode of procedure was not fully accomplished, and Professor Winchell and myself have continued,

alone and unaided, to final conclusions as a result of protracted deliberations.

One individual unscientifically proposed that the conclusions of Miss Frances E. Babbitt must be adopted. The proposition was respectfully rejected as inimical to the stability of history and the value of unprejudiced inquiry.

The only conclusions permitted to enter into this final determination so far as I am to act, shall be based only on ascertained facts and acquired knowledge, and it is gratifying to distinctly understand that Professor Winchell has very agreeably enhanced that mode of procedure. His entire coöperation and aid has strengthened and sustained a desire to correctly determine the identity of the Little Falls quartz chips and blades, regardless of every personal consideration, prejudice or contention.

I therefore approach these concluding paragraphs with the utmost confidence that the final determinations are now stated in strict accordance with existing facts as they have been interpreted from apparent and specific results emanating from protracted examinations, and repeated conferences with an eminent geologist.

1. Slate rocks in situ have existed many millions of years where Little Falls, Minnesota, is now situated.

2. White quartz, a native mineral, as a result of aqueous infiltration which deposited silica in the cavities and fissures formed by strains and faults of the slate rocks, has for thousands of centuries existed as distinct veins in the schist formation at Little Falls.

3. A great North American ice-sheet enveloped that region during a period of about 50,000 years, to a depth of several thousand feet there and elsewhere. The ice-sheet moved southward, grinding and crushing exposed rocks and surface materials into the drift which now considerably covers nearly all of Minnesota, except where rock formations are exposed. The ice-sheet from the effects of changing aerial temperatures gradually disappeared toward the north, precipitating tempestuous floods during the closing period of the glacial epoch. Those geologic changes caused billions of boulders, cobbles and

pebbles to be intermixed into the drift with clays, gravels and sand. Numerous indications point with unerring certainty to the fact that climatic changes occurred regularly and seasonably, creating near the close of the glacial epoch spring, summer, autumn and winter temperatures approximately the same as they now exist at Little Falls, Minnesota, the extremes indicating about 100° and -40° Fahrenheit. It is immaterial whether the drift did or did not entirely overspread the quartz-veined slate rocks at Little Falls at the time the ice-sheet existed there. Morainic and kame-like hills which are permanent between Little Falls and Fort Snelling, indicate that the channel of the Mississippi River at its glacial flood-stage was gradually formed, beginning at the mouth of Minnesota River and extending northward to and beyond Little Falls by successive stages of floods which increased or decreased repeatedly, according to excessive changes in temperature during winter and summer seasons, until the ice-sheet had entirely disappeared. The maximum flood-stages washed out all the clays from the till and spread the sandy and gravelly modified drift into a flat plain which extends from Minneapolis to Little Falls and Crow Wing.

That plain which formed the bed of the Mississippi is from two to five or more miles in width and more than 130 miles long extending in a general north and south direction. The currents which modified the drift, distinctly stratified the cobbles, pebbles, gravels and sand, which indicates that the glacial floods were of periodic duration. Flood-stages and low-stages of flowing waters were of common occurrence at Little Falls until the ice-sheet finally disappeared entirely, when the Mississippi River by erosion was diminished from the plain until it withdrew within its present and narrow streambed four or five hundred feet wide and from ten to twenty or more feet in depth. Hot weather in summer months precipitated floods from the melting ice, and excessive frigidity during winter seasons almost if not completely closed the river as the waters receded, which exposed numerous sandbars, leaving many places across the diminished channel of the stream entirely dry, to be again overflowed when mild temperatures reappeared, causing a seasonable continuance of the

glacial floods which were to be again reduced by the approach of another winter, and tumultuously renewed when the heat of a succeeding summer temperature transpired.

4. At Little Falls all the peculiarities described in No. 3 prevailed in progressive order, beginning at a time when the ice-sheet overspread the slate rock, and ending when the moderated temperatures had caused the entire disappearance of the glacial period, intermediate winters and summers having regularly appeared and passed, with their overwhelming influences of closed and open flowages at low and high water stages in the Mississippi River.

Excavated pits, exposed walls of gravel beds, and ascertained altitudes distinctly disclose the natural conditions which existed there. Beginning at the eastern limit of the plain which formed the streambed of the glacial river at a somewhat contracted narrows immediately opposite the quartz-veined slate, and proceeding westward to and across the present streambed of the Mississippi at the falls, a cross section discloses explicitly that an ancient sandbar island was formed against the east end of the exposed slate.

Hole-in-the-day Bluff bordered the east bank of the Mississippi at the period when the currents of that river were modifying the drift, and there is a distinct westward curvature of the morainic hills which form that bluff immediately opposite Little Falls. That curvature forced the flowing waters into a narrower streambed than existed north or south from the present falls, forming two swiftly flowing channels, one around and over the slate rocks and one against Hole-in-the-day Bluffs, which culminated in two broad and deep channels, one east and one west of the present east end of the Little Falls dam. Those phenomena created a sandy and gravelly shoal in the middle of the river against the slate. As winter temperatures approached and the waters receded, the shoal became an island subject to repeated overflows until the ice-sheet entirely disappeared, when the Mississippi withdrew to narrower channels over and through decomposing slate, as those channels now exist, segregating the sandbar island and the bed of the river along its eastern side into a sandy and gravelly plain several feet higher in its natural altitudes than is

the west bank of the Mississippi at Little Falls. It follows as an ascertained fact that the sandbar island must certainly have been gradually formed by overflowing currents of the river which washed into place the cobbles, pebbles, gravels and sand of which it is constituted, and existing stratified conditions and higher altitudes prove that important conclusion.

Into the materials of that water-deposited and stratified sandbar formation white quartz blades, chips, spalls and cores enter as a considerable portion of their composition, occupying a depth of several feet and a length and surface breadth of several hundred yards.

5. The crest of that sandbar without artificial appliances is incapable of producing a forest of timber. Its exposures are sun-parched and nearly barren.

6. The paleolithic differentiated quartz blades and chips observed at Little Falls are most numerically excessive at and in the sandbar formation adjoining the east end of the milldam.

7. The materials of which that sandbar was originally formed are constituted of modified drift and artificially chipped quartz objects, intermixed. The cobbles, pebbles and gravels are waterworn and water-deposited. The quartz blades and chips are sharp and unmodified.

8. The crest of that sandbar has never been disturbed, overturned or changed by windfalls.

9. The time immediately preceding the present since the ice-sheet disappeared from the neighborhood of Little Falls has been computed at about 10,000 years by competent geological authority.

10. At a period of time when the glacial epoch closely approached its end, and at a date when the sandbar formation was naturally outlined and in compact existence, man appeared at the crest of that sandbar immediately in contact with an adjoining quartz-veined ledge of slate. He quarried the white mineral, forcibly fractured its materials, and chipped rude blades from its spalls, depositing large quantities of workshop debris over the surface of the sandbar. His operations there were continued for a long period of time, during which many seasons of floating ice and high stages of water in the Mississippi overspread the plain, submerged the sandbar, overturned and covered up his

blades and chips and receded. As the ice gorges and overflows seasonably disappeared, the same people again approached the crest of the sandbar and continued their operations as quarrymen and chippers of the white mineral. That primitive and ancient industry was continued until the Mississippi River at Little Falls ceased to be an overflowing glacial watercourse, when they proceeded with their operations on the surface of the plain near the quarries for a limited period of time, finally disappearing from the locality at or near the date when the ice-sheet receded from the Basin of the Mississippi, leaving their quartz blades and chips promiscuously intermixed with water-deposited modified drift.

11. From the period when primitive man first appeared at Little Falls until the present date the surface of the plain at that locality has from time to time been subjected to severe and penetrating temperatures, which have solidly frozen and quickly thawed that surface to a depth of about six feet, slightly but universally disturbing the overspread modified drift. That slight disturbance was enhanced by the footprints of man, ice gorges, overflowing waters, ants and insects, the roots of shrubbery and the lapse of time, but the stratification is sufficiently intact, as shown in Plate XX at page 62, to certainly and absolutely demonstrate that primitive man was present and chipping quartz at the time when fluctuating glacial floods were periodically stratifying the gravel beds where his implements rest.

12. "The Notch" was probably also the scene of primitive activities, but it is not a suitable place for technical tests on account of backwater overflow, tree roots and sliding talus.

13. Quartz objects are rarely present in the gravel beds on the west side of the Mississippi at Little Falls, and at no place on that side of the river could they be found to exceed two feet below the surface.

14. No evidences were observed certainly indicating that any primitive tribe or band occupied the region at Little Falls between the time when the paleolithic quartz blades were made and the unknown prehistoric date when ancient mound builders appeared at Kakabikansing as temporary and transient occupants not earlier than

the dawn of the first century A. D., a difference in time basis of several thousand years.

15. It does not require that we imagine or presume that paleolithic man preceded the mound builder at Little Falls; for every discovered fact certainly indicates his presence there when the northern portion of Minnesota was enveloped beneath the last glacial ice-sheet, about B. C. 7,000, or even 1,000 years earlier than that very ancient date.

16. No potshards, arrowpoints, spearheads, stone axes, grooved hammers or any other neolithic or mound builder artifacts have ever been, or can now be found associated with the quartz blades beneath any of the cobbles and pebbles at Little Falls.

17. There is no evidence to show that man was at Little Falls when the ice-sheet rested at or over the quartz veins. He came when the sandy plain was in process of formation as the streambed of the Mississippi when it was a glacial river.

18. The occupancy to him was important as a base of supplies. It follows that there were sexes, births and deaths. Only one primitive art is manifest: the conchoidal fracture of a paleolithic quartz blade.

Who were they?

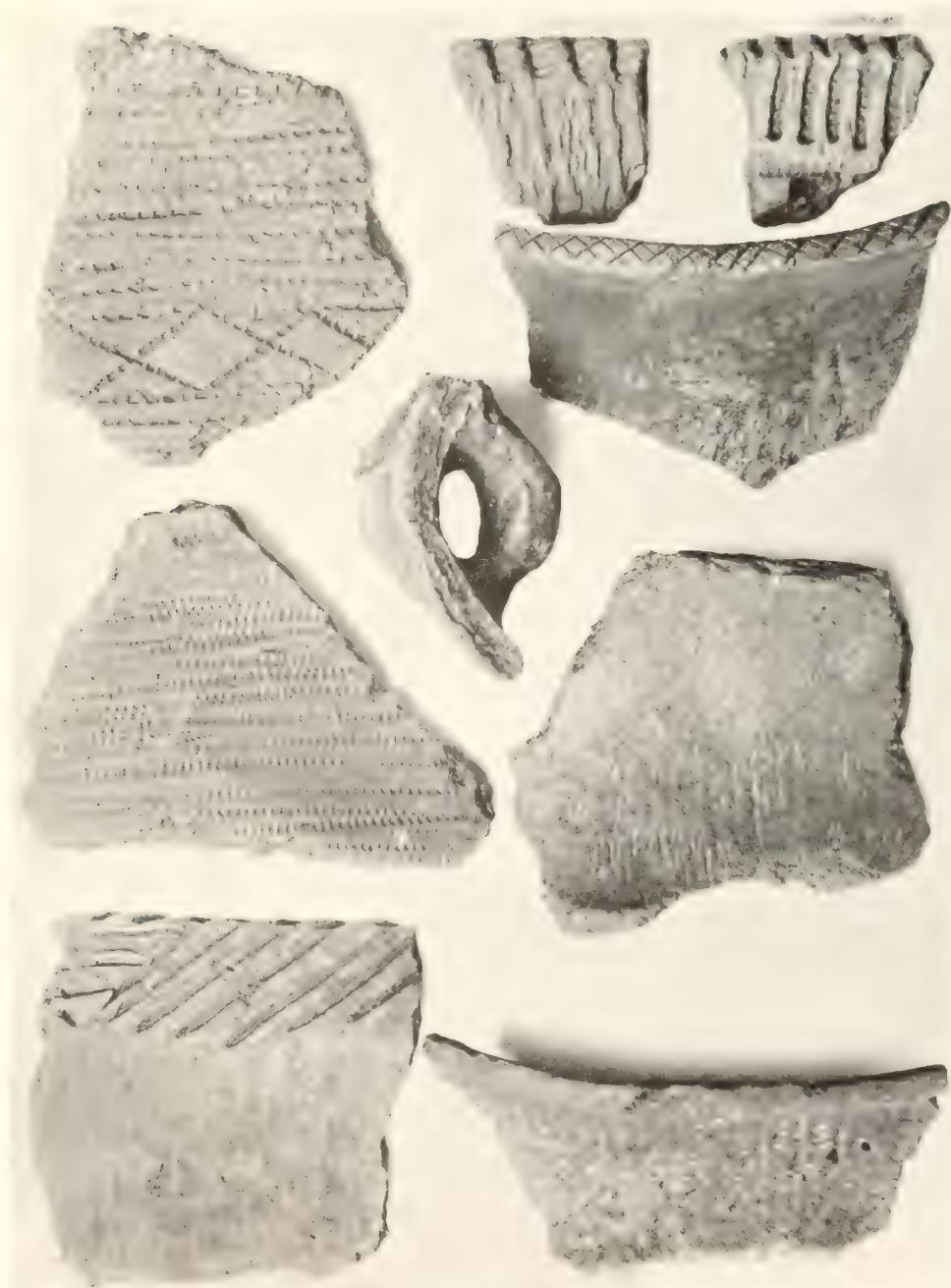
From whence did they come and their departure?

The human family sprang from anthropoid apes; the evolution undoubtedly covering a period of 200,000 years. That might place his cradle beyond America; hence it is devoid of proof to say that he was autochthonous in the Basin of the Mississippi.

He did not seem to go south with the ice 60,000 years ago. His rude blades are too scarce in the Basin of the Mississippi to indicate a time basis of that magnitude.

He appeared at the horizon of the lake-dotted land of Minnesota as the ice-sheet disappeared. Then he also disappeared.

It is a permissible liberty to presume that his ancestors were of an Oriental caste, and that his descendants are now subsisting upon the oil of the walrus during an Arctic night in the distant north.



NEOLITHIC POTSHARDS FROM KATHIO.

Many thousands of pieces of broken clay vessels are scattered over the surface of the drift in Northern Minnesota. Not one single piece was or could be found under the glacial gravels at Little Falls, Minn., where the quartz implements rest.

A P P E N D I X .

GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA.

MINNEAPOLIS, MINN., November 26, 1900.

HON. J. V. BROWER:

I was delighted to find on my table last Saturday your beautiful book *Mille Lac*, and I wish to express my thanks and my gratification that one of our own citizens has taken up and carried through so important a scientific investigation with such strictly scientific methods.

I am the more gratified that you reach the result that you do, after so exhaustive investigation, viz: that the mounds were the product of the present Indians and not of some hypothetical mysterious predecessor, because several years ago, after an investigation of the mounds, and of the mines of Isle Royal, I arrived (next after Lapham), and contrary to the then prevalent opinion and to my own expectation, at the conclusion that both the mound builder and the ancient copper miner was the ancestor of the present tribes of aborigines, and I published that conviction in the *Popular Science Monthly*.

At the present time the Bureau of American Ethnology accepts that view, and all its work runs on that fundamental tenet.

I congratulate you and the State on so thorough and beautiful work—i. e. if the State deserves any credit in a piece of work carried through by private means. Very truly,

N. H. WINCHELL.



PRIMITIVE MAN IN THE ICE AGE.

BY

WARREN UPHAM.

According to a request of Hon. J. V. Brower, an attempt is here made to trace, very concisely, the derivation of the American race of mankind, its route and time of immigration to this continent, and the relation of primitive man to geology and especially to the Ice age. It is a theme most interesting to me because of my studies of the glacial drift in the northern part of the United States and adjoining parts of Canada, supplemented by observations at many places in the British Isles, Scandinavia, Denmark, Germany, and Switzerland. To the investigation of the glacial period and its diverse drift formations, these questions of the origin, antiquity, and migrations of mankind are very intimately and indeed inseparably allied.

The birthplace of our species was undoubtedly somewhere in the warm regions of the eastern hemisphere. In the rock formations of the Old World, belonging to the late geologic era termed Tertiary, fossil remains of anthropoid apes are found, but none are known in the rocks of our western continent, either of North or South America. They are our nearest animal kin. The great tropical regions of the Old World, therefore, where they still live and where their and our backwardly convergent lines of ancestry are made known, though very fragmentarily, by the testimony of the rocks, must be regarded as the source of our now cosmopolitan human species.

In the very remote past, some race of the ancestral stock acquired articulate speech to express their thoughts, and this led to more and better thought. Fire, the mysterious gift of nature to man's dawning intelligence, cooked his food. Thereby he grew stronger and more crafty, and gradually extended his geographic range into the colder northern and southern temperate zones. To the genial comfort of a fire for the preparation of food and for warmth in winter, he added, when cold and exposure required, the skins and furs of beasts as

clothing. Wandering tribes of men were then able to brave the cold of the high northern latitudes.

The first people in America appear to have migrated to our continent from northern Asia during the early Quaternary time of general uplift of northern regions which immediately preceded the Ice age, being its principal cause, and which continued through the early and probably the greater part of that age. Then, land undoubtedly extended across the present area of the shallow Bering sea. It is not improbable, too, that another line of very ancient immigration, coming by a similar early Quaternary land communication where now are wide tracts of the sea, passed from western Europe by the way of the Faroe islands, Iceland, and Greenland, to this continent. The very distant and dim antiquity of these migrations, however, will perhaps always forbid our looking back with clear and certain view, to trace their relative importance and their respective contributions to prehistoric American industries, traffic, customs, myths, and racial characters.

Whenever Japanese or other Asiatic sailors have been driven by storms to the North Pacific shores of our continent, as is known to have happened many times during hundreds of years past, the survivors have been mingled with the American tribes, without perceptible effect, beyond perhaps a few myths or some advancement in making weapons, utensils, or ornaments. There have also been frequent traverses of Bering strait by the Eskimos and their Asiatic neighbors within the historic period, but without notable migration in either direction to modify the racial characteristics of either continent.

An objection against migrations of primitive man to this western hemisphere during the glacial period may be based on the ice-covered condition of North America at that time, wholly enveloped by an ice-sheet upon its northern half, northward from the Ohio and Mississippi rivers, excepting the greater part of Alaska. If the preglacial and early glacial altitude of the continent had been the same as now, this objection would be valid, and we should be obliged to refer these ancient migrations wholly to a time before the accumulation of the North American ice-sheet, which reached both east and west beyond

the present coast lines. But the land elevation then, as known by old river valleys submerged beneath the sea and by marine shells of littoral and shallow water species dredged at great depths, was 3,000 to 8,000 feet greater than now. During the epoch of ice accumulation and culmination, its boundaries probably failed to reach generally to the coast line of that time. Along the sea border, where food supplies such as savages rely upon are most easily obtained, preglacial and glacial man may have freely advanced on a land margin skirting the inland ice, as along the present borders of Greenland. It was only in the Champlain epoch, closing the glacial period, that the ice-burdened lands sank to their present altitude or lower, bringing the edges of the ice-sheet beneath the encroaching sea.

It is impossible to define closely the date of man's coming into America; but it is known to have preceded the end of the glacial period. In the late glacial gravel deposits of the Delaware valley at Trenton, New Jersey, under a beach ridge of the glacial lake Iroquois in western New York, in late glacial valley deposits of Ohio, in the similar floodplain of the Mississippi at Little Falls, Minnesota, as described in this volume, and in a beach ridge of the glacial lake Agassiz in northwestern Manitoba, geologists have found traces of man's presence during the closing scenes of the Ice age. The earliest of these discoveries, at Trenton, was only one or two years before the observations by Professor Winchell, in 1877, at Little Falls.

The many divergent branches of the American peoples and their remarkable progress toward civilization in Mexico, Central America, and Peru, before the discovery by Columbus, indicate for this division of mankind probably almost as great antiquity as in the eastern hemisphere, where many lines of evidence point to the origin and dispersion of men at a time far longer ago than the 5,000 to 10,000 years which measure the postglacial period. Although we are unable to define the date in thousands of years of antiquity, when the American race came into its heritage, we may paradoxically say that it came here before it had been differentiated from the primordial stock of mankind so as to be racially distinct.

Development of the physical and mental characteristics of the

American race doubtless went forward in companionship with the development of their industries, tribal organization, and advancement toward civilization. All these changes, from a very low condition of savagery to semi-civilization in some districts, great diversity of tribal and national life, high skill in various handicrafts, and general contrast with the races of the Old World, took place, as I believe, after the aboriginal migration to America. This development was probably synchronous with the differentiation of the black, yellow, and white races; and their establishment was complete long before the pyramids of Egypt were built, and, indeed, long before the Aryan invaders of western Europe, in the closing part of the Ice age, brought the neolithic arts, cultivated plants, domestic animals, and the Indo-European languages.

My studies as a glacialist lead me to think that Flinders Petrie has given as satisfactory estimates as can be made with our present knowledge in his recent suggestions assigning 100,000 years as the probable duration since paleolithic man appeared in the Somme valley, and 10,000 years since neolithic man came into western Europe. From my examination of the implement-bearing gravel deposits of the Somme in northern France, where proofs of man's great geologic antiquity were first recognized and published, I concluded that paleolithic men began their occupation of that country before the epoch of great elevation of the lands which became glaciated, probably contemporaneously, in both Europe and America (*American Geologist*, Vol. XXII, pp. 350-363, Dec. 1898). The glacial period, intervening between the oldest Somme gravels and the coming of the neolithic people, had a duration of probably 50,000 years, or perhaps more nearly 100,000 years. Eolithic man, known by his very rude stone implements in stream deposits which are preserved on high plateaus in southern England, belonged doubtless to a time considerably earlier than 100,000 years ago; so that we may perhaps allot twice that period for the existence of mankind and the development of the four great races of white, black, yellow, and red men. But however long, as 200,000 years, we may estimate the duration of the human species, geology confidently affirms that life began upon our globe in an antiquity

about a thousand times more remote, and the beginning of the existence of the earth and the solar system was again vastly more ancient.

Six great eras comprise all geologic time, as follows:

1. The Azoic or Early Archean era, without life.
2. The Eozoic or Late Archean era, with the dawn of life.
3. The Paleozoic era, with old types of life.
4. The Mesozoic era, with intermediate types of life.
5. The Cenozoic or Tertiary era, with new types of life.
6. The Psychozoic or Quaternary era, with soul life.

Each of the three eras first named was exceedingly long. The fourth was probably only a quarter as long as either of those preceding, but in turn it is estimated to have been about three times as long as the fifth era. Lastly, the Psychozoic era, extending to the present time, has been comparatively very short. But this short era has the greatest significance to us, because then, as its name implies, "man became a living soul," the crowning glory of the animal kingdom. Geologically, this era has been characterized by very exceptional movements of grand continental uplifts and subsidence, with glaciation of northwestern Europe and half of North America.

The relationship of man to the Ice age and to this entire era is shown by the following table:

PERIODS AND EPOCHS OF THE PSYCHOZOIC OR QUATERNARY ERA.

LAFAYETTE PERIOD.

Lafayette Epoch. Deposition of loam, sand, and gravel, on the coastal plain of the Southern Atlantic and Gulf states; Eolithic man in western Europe.

Ozarkian Epoch. Great uplift of North America and of northern and western Europe and western Africa; erosion of the Lafayette deposits; beginning of the North American and European ice-sheets; earliest paleolithic man in the Somme valley before the uplift began there.

GLACIAL PERIOD.

Glacial Epoch. Continuance of high land elevation, before noted, causing snowfall on these uplifted continental plateaus throughout the year; variations, by alternate stages of growth and decrease in area, of the ice-sheets; comprising the Paleolithic period as studied in France, in its Acheulian, Mousterian, Solutrian, and Magdalenian stages; development of the white, black, and yellow races in the Old World, and of the red race in America.

Champlain Epoch. Depression of the formerly uplifted lands, with consequent restoration of temperate climate; melting of the ice-sheets, with deposition of their glacial and modified drift; formation of marginal moraines, marking pauses in the recession of the ice borders; glacial lakes, as Lake Agassiz, held by waning ice barriers; men in the northern United States and Canada following close to the receding ice boundary; Neolithic men occupying northwestern Europe immediately after the ice-sheet melted.

POSTGLACIAL PERIOD.

Prehistoric Epoch. Moderate re-elevation of the glaciated lands from their Champlain depression; much erosion of the modified drift in river valleys; mounds in the United States built by ancestors of the present Indians; semi-civilization in Mexico, Central America, and Peru; the Neolithic, Bronze, and Iron ages in Europe; civilization attained in Mesopotamia, Egypt, and China.

Historic Epoch. Deposition of alluvium, peat, etc.; vast progress of inventions, arts, literature, sciences wealth, just government, and philanthropy.



TYPICAL MOUND BUILDER SPEARHEAD, POINTS AND BLADES FROM THE MILLE LAC REGION. 1.

The following map illustrates a mound builders' village site, mound group, inclosure, and embankments at Garrison Creek. The village site is thirty-five miles northeast of Little Falls, Minnesota. The artifacts were collected from Kattho village sites at Mille Lac.

The plates are introduced as evidences of differentiation.

NOMENCLATURE.

But little can be offered concerning nomenclature at Little Falls, Minnesota. Ka-ka'-bik-ans'-ing is the Ojibway Indian name for that place, explained as follows:

BENA, MINN., January 2, 1902.

HON. J. V. BROWER,

Dear Sir:—Your letter of December 31st, asking about the Ojibway words Kakabika and Kakabikans, is received.

Kakabika is from the words Kakaka—square, and ahjibie—rock, forming the word Kakabika—squarely cut off rock, generally applied to waterfalls by Ojibway Indians.

Kichi (large or great) Kakabikans is St. Anthony Falls.

Kakabikans, from Kakabika and ans (small), an adjective added, signifies a “small square cut off rock,” or small falls. Little Falls and Fergus Falls are both called Kakabikansing, or the place of the little squarely cut off rock or waterfall.

I have never heard why the Ojibways called Little Falls—Ka-ka-bik-ans-ing, and inquiry elicits no reason, but I infer that it is owing to the steep rapids.

White quartz—Winin wabik, from winin—fat, and wabik—metal or rock. Therefore the Ojibway people call white quartz winin wabik, or fat rock, from its resemblance to layers of fat in an animal.

The slate around Little Falls being dark would be called Ma-ka-de-a-ji-bik, black rock.

I have heard slate rock such as is to be found at Cloquet called Pi-gish-kan-i-ji-bek—rotten rock. Very truly yours,

C. H. BEAULIEU.

Rev. J. A. Gilfillan says that “ing” at the end of Ka-ka-bik-ans-ing means “at” or “to.”

Omushkozo sibi is Little Elk River. Wabiziwi sibi is Swan River. Ga-Nijotigweiag sibi is Two Rivers.

The present names are translations from the Ojibway language.

Hole-in-the-day Bluff is named after an Ojibway chief, whose real name was “Hole-in-the-clouds.” His remains lie buried on the crest of the hill which bears his name.

THE QUIVIRA HISTORICAL SOCIETY.

BY THESE PRESENTS it is ordered and determined that an association of explorers, authors and ethnologic students is hereby organized for the prosecution of investigations, and the perpetuation of results concerning the ancient and more recent occupancy by man of the Great West and Northwest along and adjacent to the waters of the Mississippi and Missouri rivers and their numerous branches, more particularly the region of country from Arkansas northward across Kansas, Missouri, Nebraska, South Dakota, North Dakota, Iowa, Minnesota and to the Lake of the Woods and Manitoba, and thence to the crest of the Rocky Mountains, U. S. A.

First. The name of this association shall be THE QUIVIRA HISTORICAL SOCIETY.

Second. John T. Keagy, Elmer E. Blackman, Jacob V. Brower, George W. Reinsburg, Edward A. Kilian, A. E. Sheldon and A. O. Hollingsworth are hereby declared to be life members of this society. Robert Henderson, J. Sterling Morton, Warren Upham, George Bryce, Adolf F. Bandelier, Johan A. Udden, W. J. Griffin, Frederick W. Hodge, F. B. Elliott and George Parker Winship are nominated and confirmed as honorary members.

Third. The transactions of the Quivira Historical Society shall be directed by the life members thereof, of which a majority shall constitute a quorum for the determination of all questions and proceedings.

Fourth. The society shall have a president, vice-president, secretary, and an executive committee.

Fifth. Until otherwise provided and ordered the officers of this society shall be as follows: Jacob V. Brower, president; Elmer E. Blackman, vice-president; Edward A. Kilian, secretary; John T. Keagy, chairman of the executive committee.

Sixth. The president, vice-president, secretary, and John T. Keagy acting as chairman, shall constitute the executive committee, and shall have power to direct all the business transactions of the society.

Seventh. The Minnesota Historical Society is appointed as final custodian of the records and collections of this society. *The Con-*

Conservative, a newspaper published at Nebraska City, Nebraska, is hereby designated as the official organ of this society.

Eighth. Additional members of this society may be admitted by a unanimous ballot of the Executive Committee when in session, on call of the chairman, by and with the advice and consent of the president and secretary.

Ninth. The supreme object of this society shall be studies and discoveries in the fields of geologic, ethnologic, historic and geographic researches, and the determination of correct nomenclature, to be preserved and perpetuated in published collections, and manuscripts. Each member contributing the results of discoveries and observations shall do so over his own signature; be duly accredited with and awarded all honor for new discoveries, and this society pledges protection to each contributor against plagiarism and literary piracy.

Tenth. The erection of monuments to commemorate discoveries and to perpetuate actual historic facts and dates shall be one of the highest privileges of this society.

Eleventh. In case of a vacancy in the office of president, vice-president, secretary, or chairmanship of the executive committee by death, resignation or otherwise, the executive committee shall have power to fill the vacancy by appointment, subject to the approval of the society at the next meeting thereof.

Twelfth. All papers and articles prepared for publication in the annals of this society shall be submitted to the executive committee for approval and acceptance before the same is published.

For the perpetuation of actual historic and scientific facts we pledge our honor and the sacred name of the Quivira Historical Society, organized and instituted this twenty-ninth day of October, A. D. 1901, at Alma, Kansas.

Signed: J. V. BROWER, *President.*
E. E. BLACKMAN, *Vice-President.*
EDWARD A. KILIAN, *Secretary.*
JOHN T. KEAGY,
Chairman of Executive Committee.

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The following names and words are *passim* in this *Memoir*, and are therefore omitted from this index: Minnesota, Kakabikansing, Little Falls, Mississippi River, white quartz, slate, Indians or primitive man, mound builders, paleolithic age, neolithic age, ice-sheet, Morrison County, all geologic names, and all archæologic descriptions and names.

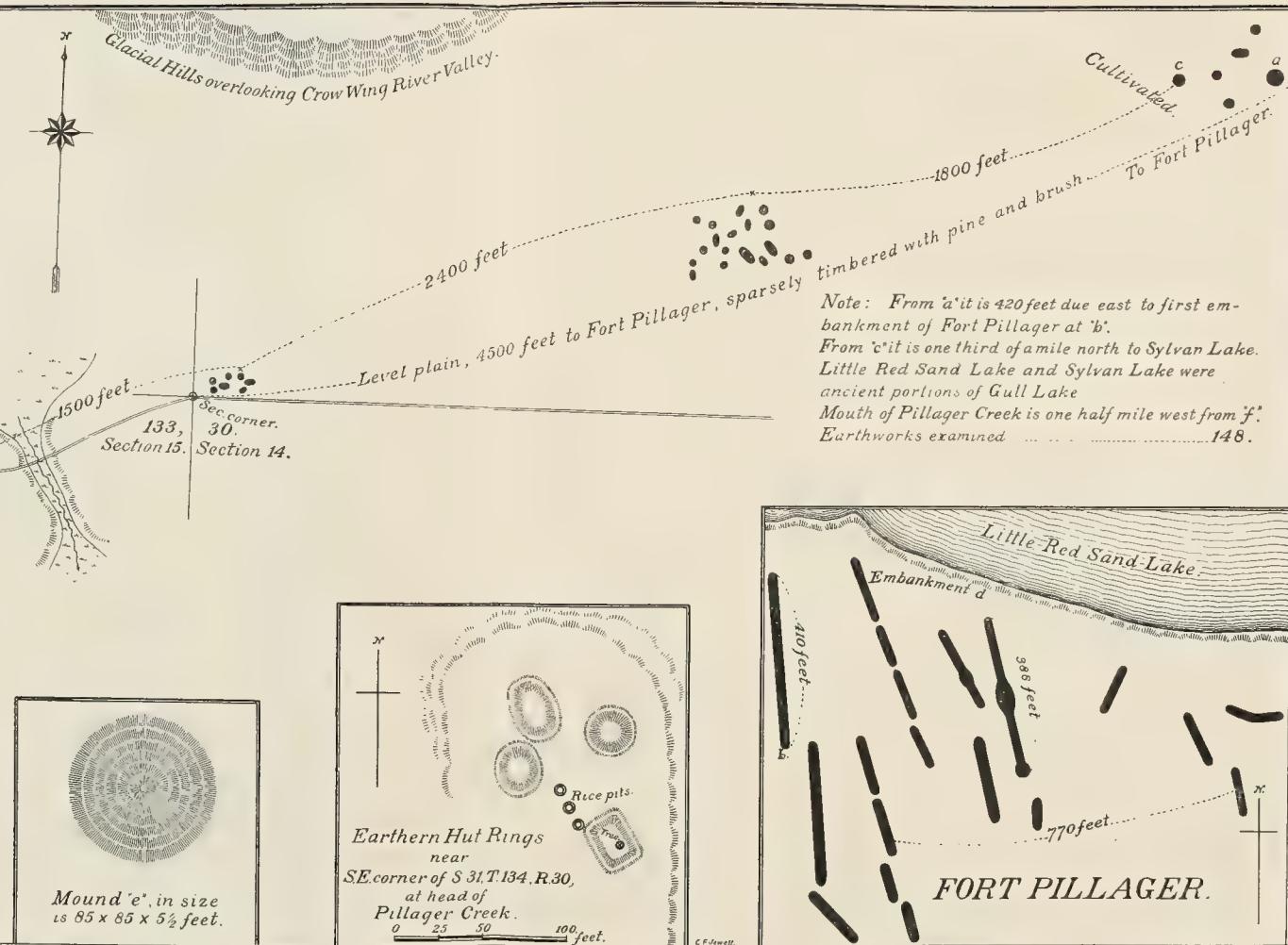
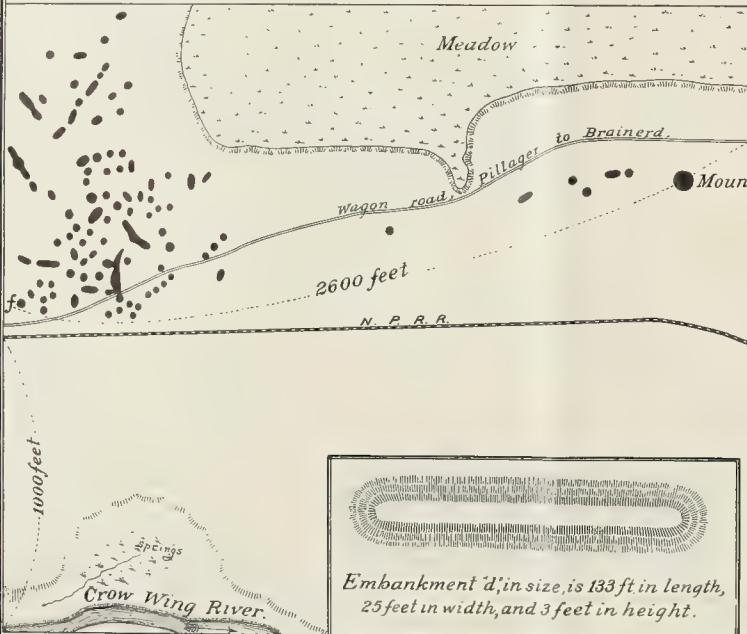
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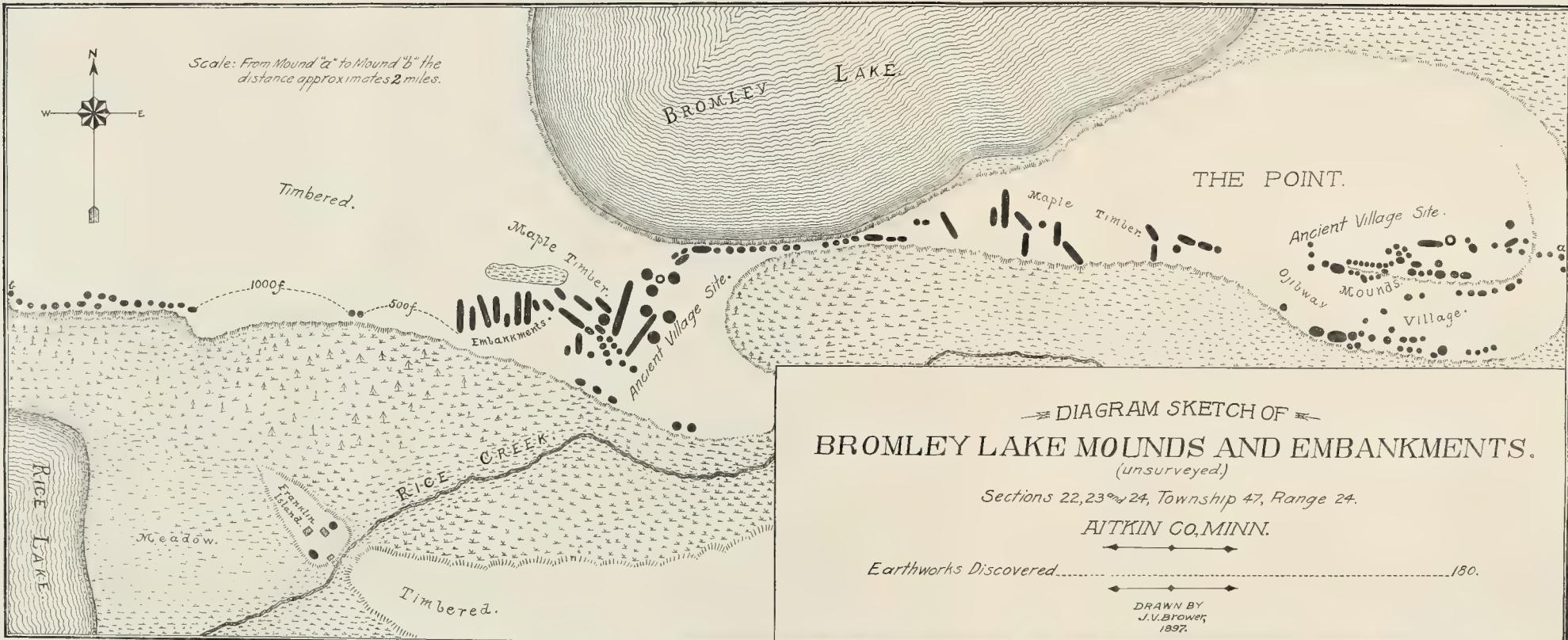
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*FIELD SKETCH
OF
PILLAGER MOUND GROUPS
AND
FORT PILLAGER,*

Cass Co., Minn.

*Drawn by
J.V.Brower
1899.*







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